

# Qualification Testing of Solid Rocket Booster Diagonal Strut Restraint Cable Assembly Part Number 10176–0031–102/103

T.W. Malone Marshall Space Flight Center, Marshall Space Flight Center, Alabama

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T.W. Malone Marshall Space Flight Center, Marshall Space Flight Center, Alabama

National Aeronautics and Space Administration

Marshall Space Flight Center • MSFC, Alabama 35812

### Acknowledgments

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## LIST OF ACRONYMS AND ABBREVIATIONS

ELV elevated temperature

RT room temperature

SRB solid rocket booster

TM Technical Memorandum

USA United Space Alliance

#### TECHNICAL MEMORANDUM

#### QUALIFICATION TESTING OF SOLID ROCKET BOOSTER DIAGONAL STRUT RESTRAINT CABLE ASSEMBLY PART NUMBER 10176–0031–102/103

#### 1. INTRODUCTION

This Technical Memorandum (TM) presents qualification test results for solid rocket booster (SRB) diagonal strut restraint cable assembly part no. 10176–0031–102/103. During flight, this assembly is exposed to a range of temperatures. MIL–W–83420 defines the breaking strength of the cable to be 798 kg (1,760 lb) at room temperature; however, it does not define cable strength at 669 °C (1,236 °F), the maximum temperature to which the cable is exposed during the first 2 min of flight. The cable, which is able to be built from different corrosion-resistant steel alloys, may also vary in its chemical, physical, and mechanical properties at the tested temperatures.

Analysis of the cable at the tested temperature, when using the standard knockdown factors for untested requirements given in MSFC–HDBK–505, "Structural Strength Program Requirements," produced negative margins of safety.<sup>2</sup> However, MSFC–HDBK–505 also stipulates conditions where a less conservative safety factor of 1.4 and less conservative knockdown factors are appropriate if they have been verified by testing.<sup>2</sup> SRB document 90PLN–0064 provides requirements for qualification testing the strut retainer assembly.<sup>3</sup>

#### 2. BACKGROUND

The restraint cable assembly is a steel cable with two terminal wire-rope clevis ends, pins, and cotter pins. The clevis ends and pins are picked from standard military specification hardware to interface with the external tank attachment ring and the diagonal strut assembly (figs. 1 and 2). The terminal wire-rope clevis ends are swaged onto the steel cable in accordance with MIL–T–6117.<sup>4</sup>

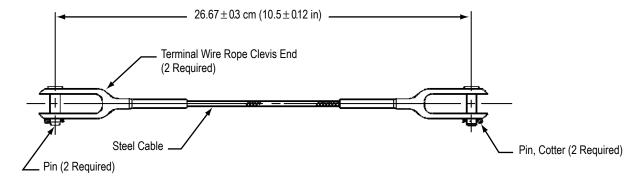


Figure 1. Strut retainer assembly.

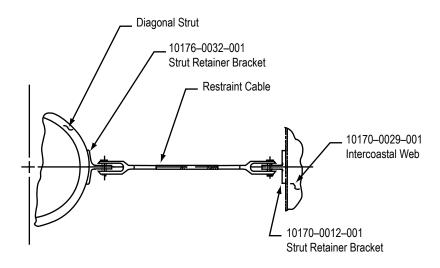


Figure 2. Strut retainer assembly installation.

This TM presents test results for three lots of MIL–W–83420, 0.317-cm (0.125- or 1/8-in) diameter, type 1 (nonjacketed) cable to loads required to restrain the diagonal strut during the first 2 min of flight and, ultimately, to failure. The first lot consisted of available flight cable assemblies that existed in United Space Alliance (USA) stock. The other two lots were obtained from new procurements, with

documentation that the wire ropes are from two different wire lots or spools. Test results qualified the available restraint cable assemblies and all future buys of restraint cables manufactured under the same procurement specifications for flight.

#### 3. TESTING AND EVALUATION

#### 3.1 Testing

Mechanical testing was completed June 6, 2004 and was performed in accordance with ASTM-E-8 and test procedure SRB-QUAL-04-0064 for the first lot of cables. <sup>5,6</sup> Five restraint cables were each pulled to failure at room temperature and at  $671 \pm 5$  °C  $(1,240 \pm 10$  °F) in accordance with the referenced procedure, 90PLN-0064, and memorandum MP41 (04-063). <sup>3,7</sup> Testing was completed for the other two lots on August 6, 2004. Ten additional restraint cables were each pulled to failure at room temperature and at 677 °C (1,250 °F) in accordance with the referenced procedure and plan. <sup>3</sup>

Table 1 shows analysis of the test results, including the calculation of a knockdown factor using methods described in chapter 9 of MIL-HDBK-5.8

Each cable was photographed before and after testing. All tests at room temperature were video-taped, and appendix A shows still images taken from the videos.

Procedure checklists were used for each test, in accordance with SRB-QUAL-04-0064, and they are shown in appendix B of this TM.<sup>6</sup>

#### 3.2 Evaluation

A value, R, was calculated for each pair of room temperature and elevated temperature tests. This value is the reduced ratio for the peak load tests at the elevated temperature, 677 °C (1,250 °F), and room temperature. Mean and standard deviations were then calculated for the R value.

Table 1. Mechanical test results.

ID	Test Temperature (°F)	Peak Load (lb)	Ratio, r
5369RT-1 (408899)	73	1776.7	_
5369RT-2 (408899)	72	1781.9	_
5369RT-3 (408899)	72	1797.7	_
5369RT-4 (408899)	72	1792.5	_
5369RT-5 (408899)	71	1779.8	_
104236RT-1	71	1900.3	_
104236RT-2	71	1863.3	_
104236RT-3	71	1899.4	_
104236RT-4	71	2008.5	_
104236RT-5	71	1981.6	_
071081RT-1	70	1956.8	-
071081RT-2	70	1954.4	-
071081RT-3	71	1891.5	-
071081RT-4	70	1925.6	_
071081RT-5	71	1939.8	_
Average	-	1883.32	-
5369ELV-6 (408899)	1,250	322.2	0.1813
5369ELV-7 (408899)	1,259	342.1	0.192
5369ELV-8 (408899)	1,258	323	0.1797
5369ELV-9 (408899)	1,254	330.3	0.1843
5369ELV-10 (408899)	1,254	337.8	0.1898
104236ELV-6	1,253	387.8	0.2041
104236ELV-7	1,259	370.6	0.1989
104236ELV-8	1,251	399.8	0.2105
104236ELV-9	1,250	392.7	0.1955
104236ELV-10	1,251	402.4	0.2031
071081ELV-6	1,251	374.7	0.1915
071081ELV-7	1,254	383.2	0.1961
071081ELV-8	1,252	388.8	0.2056
071081ELV-9	1,258	358	0.1859
071081ELV-10	1,240	361.3	0.1863
	2.9		
	0.1936		
	0.0094		
At 6	0.1892		

At the working temperature of 677 °C (1,250 °F), the lower 95-percent confidence interval estimate, or reduced ratio, of the mean percentage was determined from percentage values for each lot at that temperature. If r equals percentage values, r-bar equals the average of these values, and n equals the number of such percentages, estimated standard deviation, s, and reduced ratio, R, can be determined using the equation:

$$S^{2} = \operatorname{sum}(r - r - \operatorname{bar})^{2} / (n - 1) , \qquad (1)$$

or

$$S^{2} = \left[ \operatorname{sum}(r^{2}) - (\operatorname{sum} r)^{2} / n \right] / (n-1) , \qquad (2)$$

and

$$R = r - bar - ts/n^{1/2} \quad , \tag{3}$$

where t is a 0.95 fractal of the t distribution corresponding to n-1 degrees of freedom. In this case, the t used was t=1.753 for alpha = 0.95 and n=30.

#### 4. CONCLUSIONS

A calculated knockdown factor of 0.1892 was determined for the restraint cables. That value will be used during structural analysis of the restraint cables in the elevated temperature condition. When combined with the minimum breaking strength of 0.317-cm (0.125- or 1/8-in) diameter, type 1 composition rope according to table 1A of MIL–W–83420, this knockdown factor provides a minimum breaking strength of 151 kg (333 lb) at 677 °C (1,250 °F).

### APPENDIX A-PHOTOGRAPHS BEFORE AND AFTER TESTING

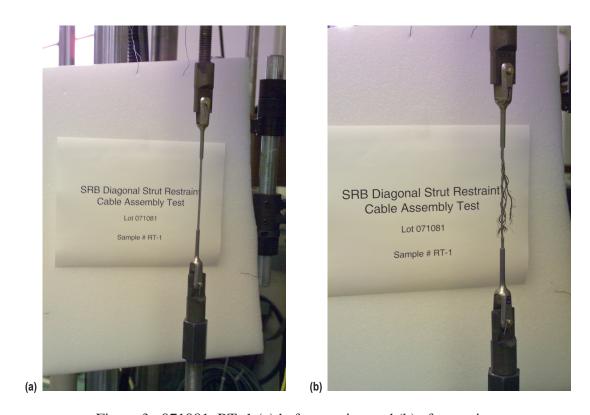


Figure 3. 071081–RT–1 (a) before testing and (b) after testing.





Figure 4. 071081–RT–2 (a) before testing and (b) after testing.





Figure 5. 071081–RT–3 (a) before testing and (b) after testing.

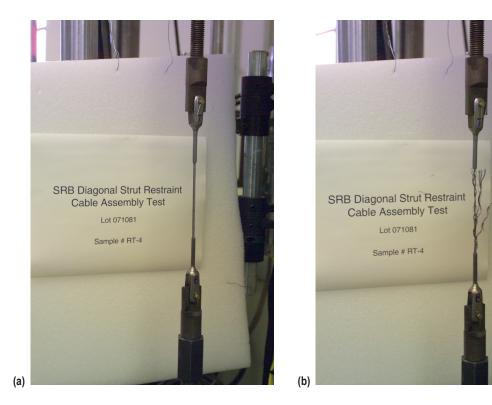


Figure 6. 071081–RT–4 (a) before testing and (b) after testing.





Figure 7. 071081–RT–5 (a) before testing and (b) after testing.

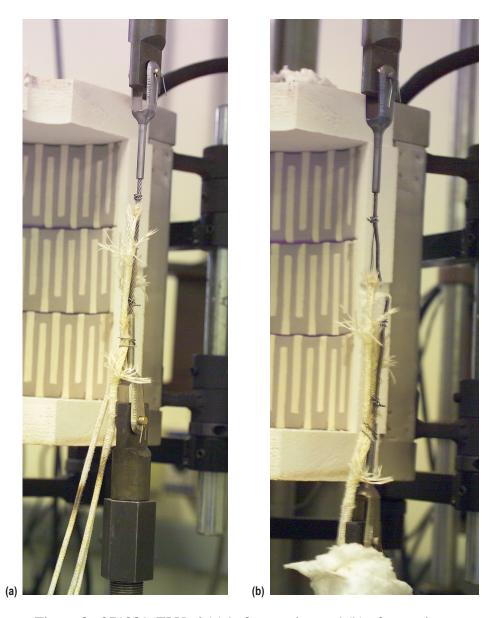


Figure 8. 071081-ELV-6 (a) before testing and (b) after testing.

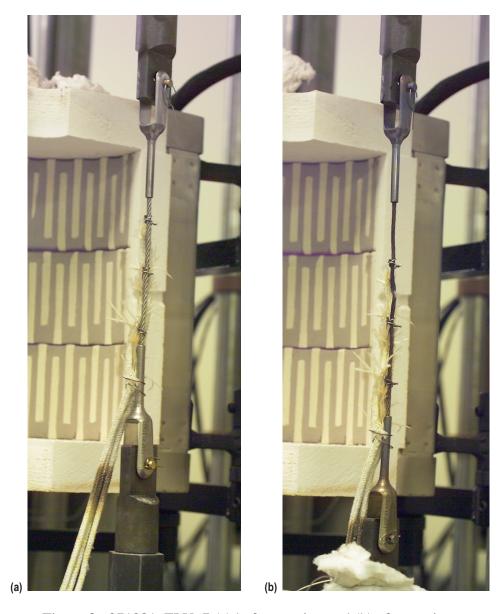


Figure 9. 071081-ELV-7 (a) before testing and (b) after testing.

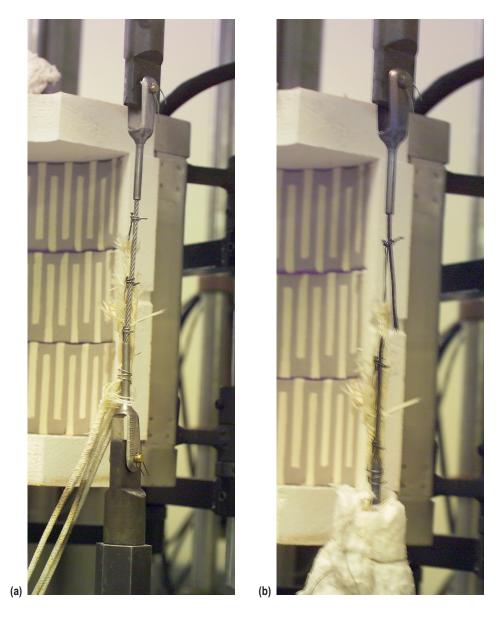


Figure 10. 071081-ELV-8 (a) before testing and (b) after testing.

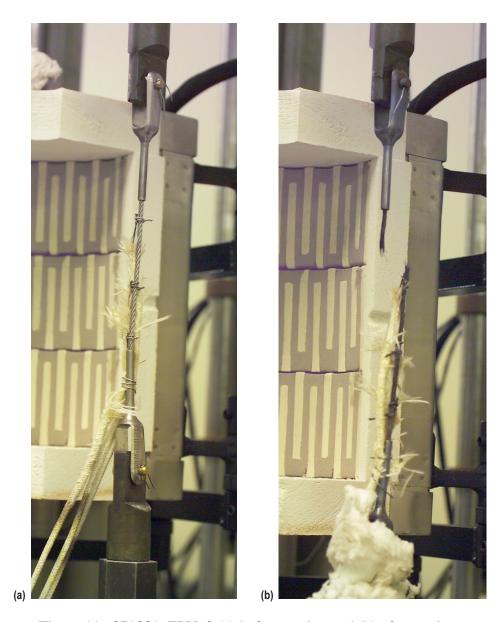


Figure 11. 071081–ELV–9 (a) before testing and (b) after testing.

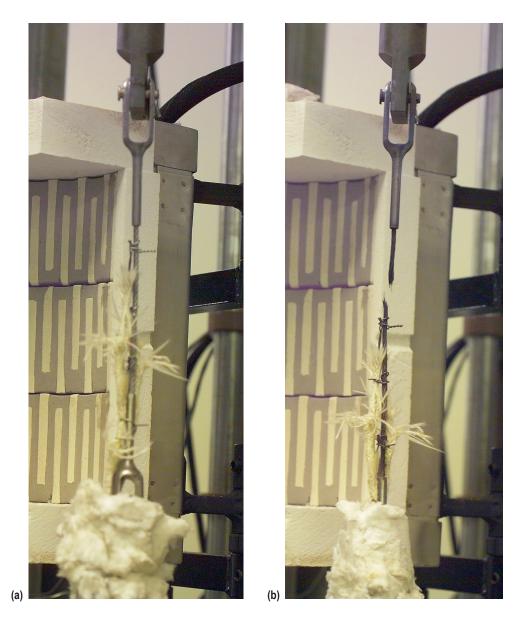


Figure 12. 071081-ELV-10 (a) before testing and (b) after testing.





Figure 13. 104236–RT–1 (a) before testing and (b) after testing.





Figure 14. 104236–RT–2 (a) before testing and (b) after testing.

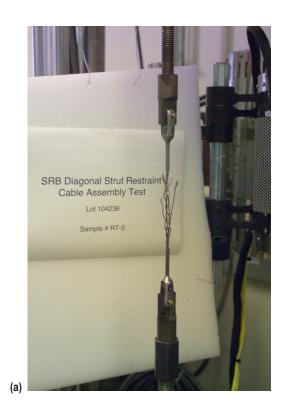




Figure 15. 104236–RT–3 (a) before testing and (b) after testing.





Figure 16. 104236–RT–4 (a) before testing and (b) after testing.

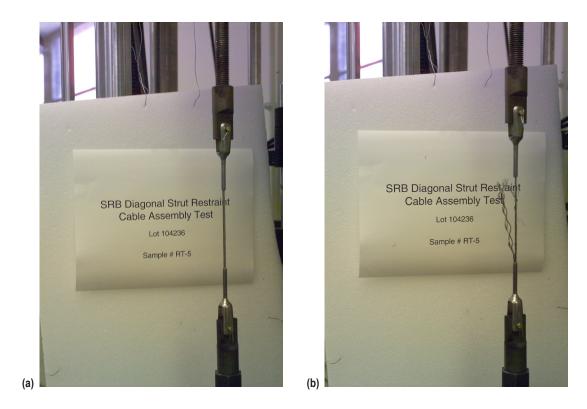


Figure 17. 104236–RT–5 (a) before testing and (b) after testing.

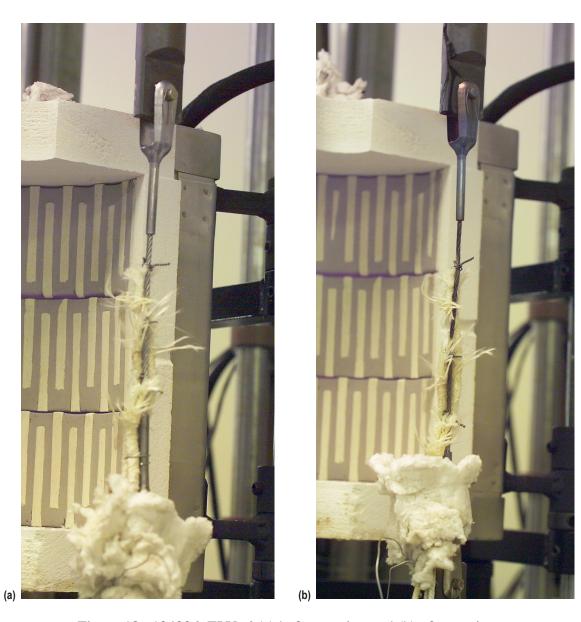


Figure 18. 104236–ELV–6 (a) before testing and (b) after testing.

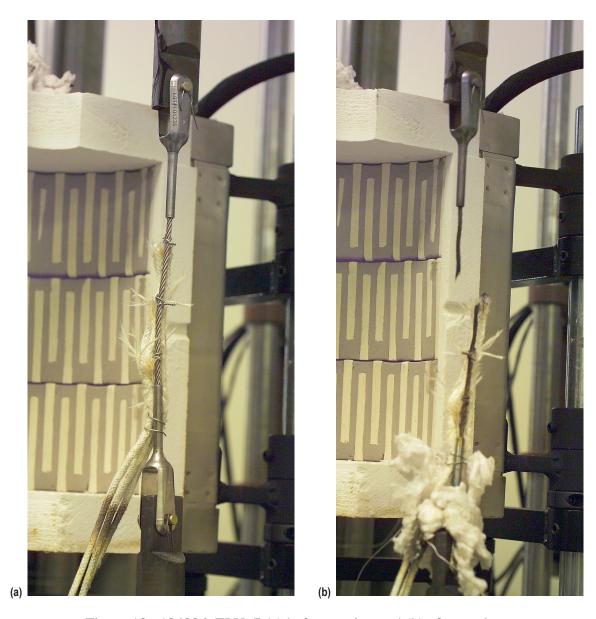


Figure 19. 104236–ELV–7 (a) before testing and (b) after testing.

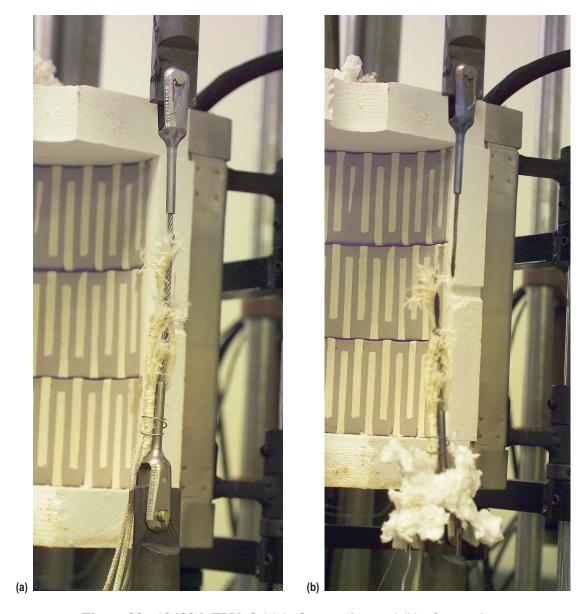


Figure 20. 104236–ELV–8 (a) before testing and (b) after testing.

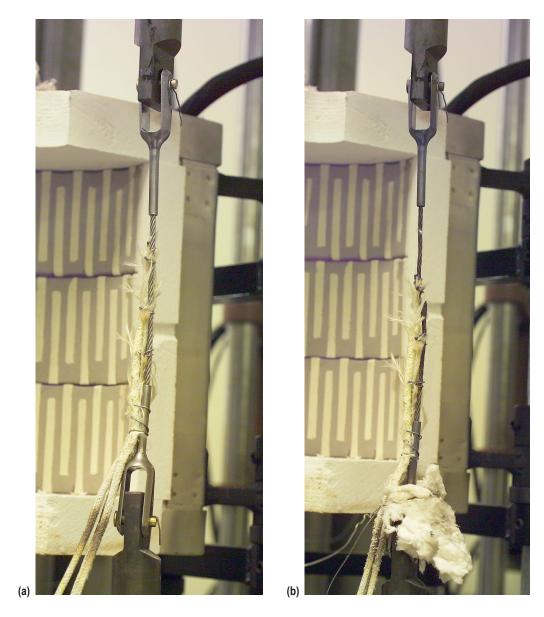


Figure 21. 104236–ELV–9 (a) before testing and (b) after testing.

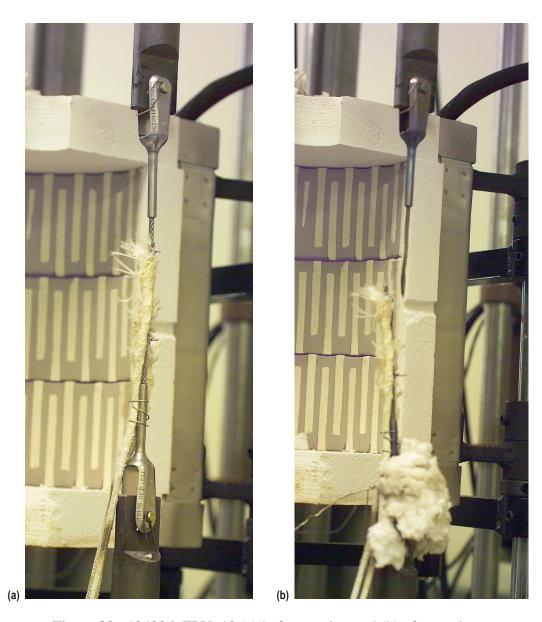


Figure 22. 104236–ELV–10 (a) before testing and (b) after testing.

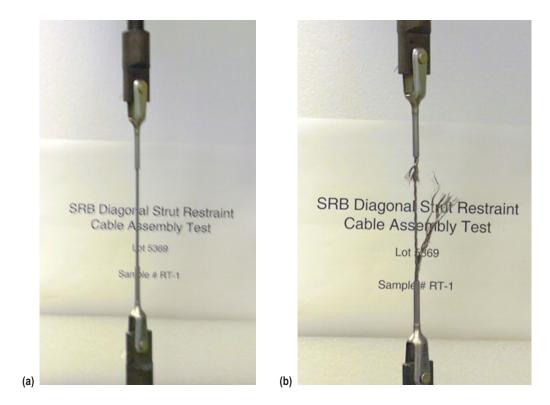


Figure 23. 5369–RT–1 (a) before testing and (b) after testing.

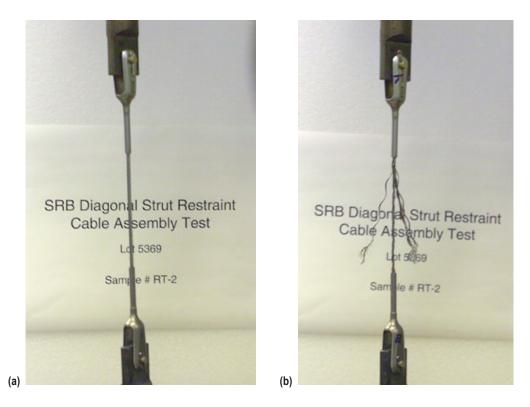


Figure 24. 5369–RT–2 (a) before testing and (b) after testing.

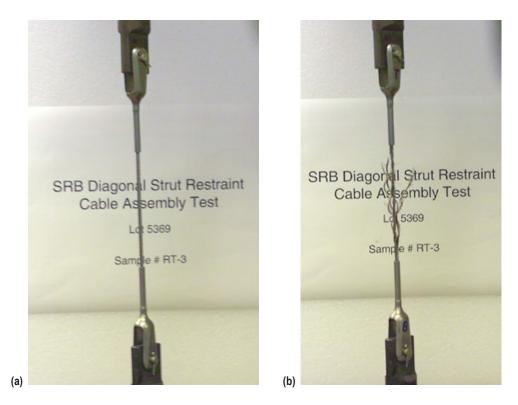


Figure 25. 5369–RT–3 (a) before testing and (b) after testing.

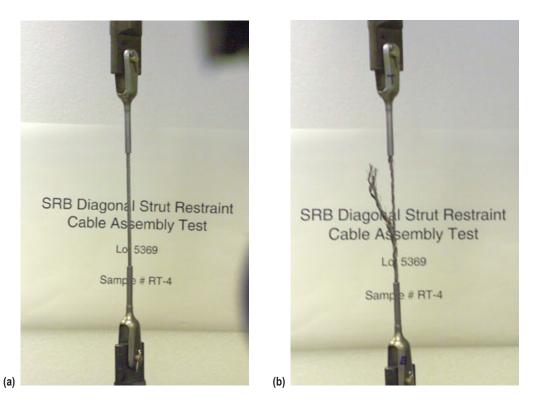


Figure 26. 5369–RT–4 (a) before testing and (b) after testing.

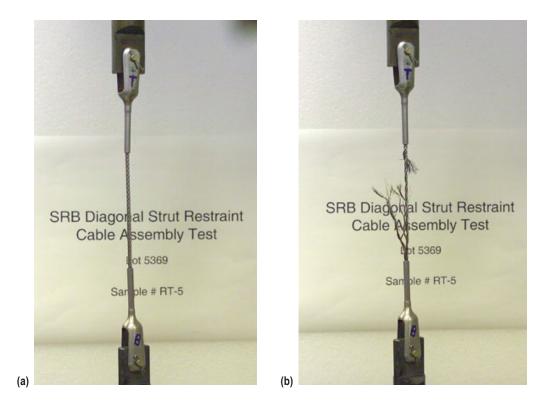


Figure 27. 5369–RT–5 (a) before testing and (b) after testing.

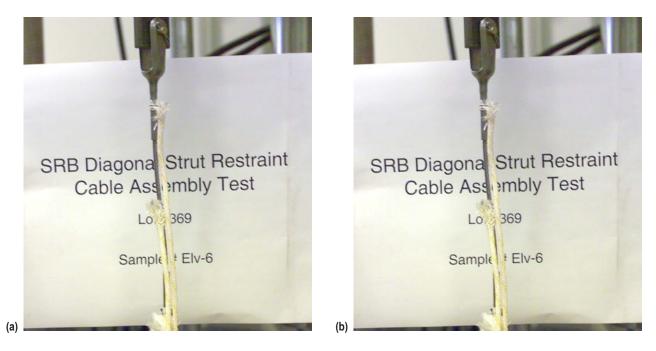


Figure 28. 5369–ELV–6 (a) before testing and (b) after testing.



Figure 29. 5369–ELV–7 (a) before testing and (b) after testing.

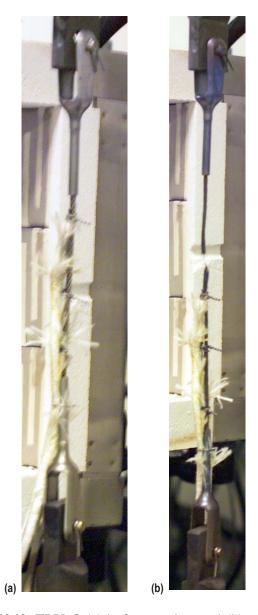


Figure 30. 5369–ELV–8 (a) before testing and (b) after testing.



Figure 31. 5369–ELV–9 (a) before testing and (b) after testing.

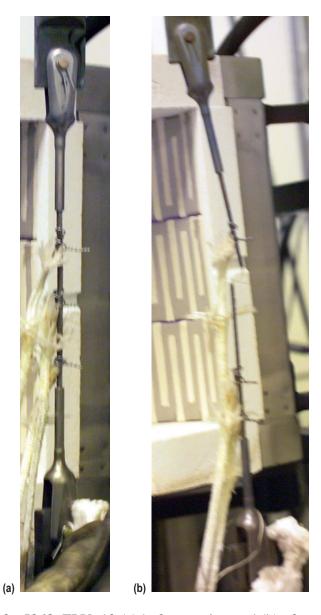
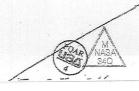


Figure 32. 5369–ELV–10 (a) before testing and (b) after testing.

#### APPENDIX B-PROCEDURE CHECKLISTS

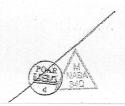
		ANICAL METALLURGY AND	CORROSION TEAM
SRB Di	agonal Strut Restraint Cable	SRB-QUAL-04-0064	Revision: Basic
	Assembly UALIFICATION TEST	Date: 7/26/04	Page 6 of 9
6.0	TEST OPERATION		
6.0.1	Verify calibration is caccordance with ED3 Verification Procedure	urrent for all calibrated t 33-WI-012 Mechanical T es	est equipment in esting Calibration and  Verify PQAR
6.0.2		or other identification for R7-1	the Restraint Cable in
	201 30	0 / 11 /	Verify PQA
6.0.3	Mount the Restraint	Cable into the fixture.	Verify PQAR PARA 7
×6.0.4	Apply three thermocon Restraint Cable.	ouples, one at the top, m	verify PQAR
6.0.5	Photograph set-up.		MIA MASA 7
¢ 6.0.6	Install furnace and he	eat to 1250F (HT tests o	nly). Verify PQAR AVA
6.0.7	Begin video.		Car L
X6.0.8	Verify all thermocoup	oles read 1250F +/- 10 d	egrees (HT tests only). N/A NASA 7.  Verify PQAR N/A
6.0.9	Document temperatu	re of test article	73° F Witness PQAR
6.0.10	Ramp load to approx inches per minute.	imately 45 pounds at a l 43, 4 /65	oad rate not to exceed 5  Witness PQAR
6.0.11	Verify load is at approfunctioning.	oximately 45 pounds and	d all instrumentation is  Verify PQAR
6.0.12	Continue increase loa	ad until failure occurs.:	Witness PQAR



		ANICAL METALLURGY AND	CORROSION TEAM
SRB Dia	gonal Strut Restraint Cable Assembly	SRB-QUAL-04-0064	Revision: Basic
QU.	ALIFICATION TEST	Date: 7/26/04	Page 7 of 9
6.0.13	Verify load and instru	mentation.	Verify PQAR
5.0.14	Stop video.		NAME OF THE PARTY
	Document load and lo Failure load _/776. Failure location:	N/A 4"-Top	swage inches from cable end Center other  Verify PQAR
.0.16	Photograph set-up.		/NÄS
3.0.17	Place broken Restrair	nt Cable debris in Ziploo	bag and identify.  Verify PQAR
] (	values, contact the fol Richard Knochelmánr Cary Cox (321) 867-1 Pat Roberts (321) 86	757	nris Epler (321) 867-9309

AHAchment#2

		HHACKMent #			
CDD	ED33 / MECHANICAL METALLURGY AND CORROSION TEAM  SRB Diagonal Strut Restraint Cable SRB-QUAL-04-0064 Revision: Basic				
SKB	Assembly	SRB-QUAL-04-0004	Revision: Dasic		
QUALIFICATION TEST		Date: 7/26/04	Page 6 of 9		
6.0	TEST OPERATION				
6.0.1		urrent for all calibrated te 3-WI-012 Mechanical Te es		MASA 7-2	
				A	
6.0.2	test:	r other identification for the	he Restraint Cable in	/NASA 7-28	
	Lot 5369	RT-2	Verify PQAR		
6.0.3	Mount the Restraint C	Cable into the fixture.	Varify DOAD	/NASA 7-29	
			Verify PQAR		
6.0.4	Apply three thermoco Restraint Cable.	uples, one at the top, mi	N	1 NASA 7-	
			Verify PQAR	M 7-28-	
6.0.5	Photograph set-up.			/NASA\ 3AC	
6.0.6	Install furnace and he	at to 1250F (HT tests on	ly). Verify PQAR	A LINASA NASA NASA NASA	
6.0.7	Begin video.		4	7-28- NASA 340	
6.0.8	Verify all thermocouple	es read 1250F +/- 10 deg	grees (HT tests only). // Verify PQAR _	1/4 /NASA 7- N/A	
6.0.9	Document temperature	e of test article. 25	Witness PQAR		
3 <del>.</del> 0.1 <del>0</del>	Ramp load to approxin inches per minute.	nately 45 pounds at a loa	ad rate not to exceed-5	MASA 7-28-0 340 POAR C	
	F	11.1	Witness PQAR _		
5.0.11	Verify load is at approx functioning.	imately 45 pounds and a	all instrumentation is	7-28-C NASA 340	
			Verify PQAR	POAR SASSES	
3.0.12	Continue increase load	until failure occurs.:	146	FOAR	



Witness PQAR

	ED33 / MECH	ANICAL METALLURGY AND	CORROSION TEAM
SRB D	iagonal Strut Restraint Cable Assembly	SRB-QUAL-04-0064	Revision: Basic
Q	UALIFICATION TEST	Date: 7/26/04	Page 7 of 9
6.0.13	Verify load and instru	mentation.	Verify PQAR
6.0.14	Stop video.		7-28-0 Y
6.0.15	Document load and lo Failure load /78/. Failure location:	9 73/4-T i	swage nches from cable end has 7-28-04 wither Verify PQAR
6.0.16	Photograph set-up.		MASA 7-28-03
6.0.17	Place broken Restrair	nt Cable debris in Ziploc	bag and identify.  Verify PQAR  Poar  4
6.0.18	values, contact the fol Richard Knochelmann Cary Cox (321) 867-1 Pat Roberts (321) 86	757	ris Epler (321) 867-9309

AHACHMEN + #3
ED33/MECHANICAL METALLURGY AND CORROSION TEAM

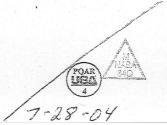
SRB D	iagonal Strut Restraint Cable	SRB-QUAL-04-0064	Revision: Basic	
Q	Assembly UALIFICATION TEST	Date: 7/26/04	Page 6 of 9	
6.0	TEST OPERATION			
6.0.1	•	urrent for all calibrated te 3-WI-012 Mechanical Te es	esting Calibration and	-28-0
6.0.2	Note serial number or test:	other identification for the	ne Restraint Cable in  Verify PQAR  Verify PQAR	28-0
6.0.3	Mount the Restraint C	able into the fixture.		8-09
<b>X</b> 6.0.4	Apply three thermoco Restraint Cable.	uples, one at the top, mid	odle and bottom of the NA NASA 7-2	28-0
6.0.5	Photograph set-up.			
<b>X</b> 6.0.6	Install furnace and he	at to 1250F (HT tests on	ly). Verify PQAR NA.	18-09
6.0.7	Begin video.			
¥6.0.8	Verify all thermocouple	es read 1250F +/- 10 deg	grees (HT tests only). 14 MASA 7-28 Verify PQAR 44	8-04
6.0.9	Document temperature	e of test article	Witness PQAR Witness PQAR	8-04
6.0.10	Ramp load to approximate inches per minute.	nately 45 pounds at a loa 41,1165	Witness PQAR	\$-04
6.0.11	Verify load is at approx functioning.	rimately 45 pounds and a	All instrumentation is  Verify PQAR	8-0
6.0.12	Continue increase load	until failure occurs.:	Witness PQAR	/

	ED33 / MECH	ANICAL METALLURGY AT	ND CORROSIC	N TEAM	
SRB Diagonal Strut Restraint Cable Assembly		SRB-QUAL-04-0064	SRB-QUAL-04-0064		
QT	JALIFICATION TEST	Date: 7/26/04		Page 7 of 9	A
6.0.13	Verify load and instru	mentation.		Verify PQAR	NASA 7
6.0.14	Stop video.				(USA)
6.0.15	Document load and lo Failure load		_ swage _ inches fro _ other	m cable end Verify PQAR	MASA NASA
6.0.16	Photograph set-up.			USA 4	) /MASA
6.0.17	Place broken Restrain	nt Cable debris in Zipl	loc bag and	identify. Z	NASA SAO SAO SAO A SAO A SAO A A A A A A A A A A A A A A A A A A
6.0.18	IF any anomaly or tes values, contact the fol Richard Knochelmann Cary Cox (321) 867-7 Pat Roberts (321) 86 Mark Hill (256) 544-4	llowing within 24 hour n (321) 867-9813 or ( 1757 7-1757	s: Chris Epler	(321) 867-9309	7-2

7-28-04

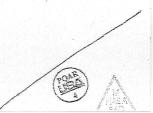
ED33 / MECH	ANICAL METALLURGY AND COR	ROSION TEAM
SRB Diagonal Strut Restraint Cable Assembly	SRB-QUAL-04-0064	Revision: Basic
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6.0	TEST OPERATION		
6.0.1	Verify calibration is current for all calibrated test equaccordance with ED33-WI-012 Mechanical Testing Verification Procedures		7-28-04
	Vermoation i roccuures	Verify PQAR	
6.0.2	Note serial number or other identification for the Restest:	straint Cable in	7-28-0
	Lot 5369 71-4	Verify PQAR	)
6.0.3	Mount the Restraint Cable into the fixture.	Verify PQAR	7-28-0
<b>X</b> 6.0.4	Apply three thermocouples, one at the top, middle a	nd bottom of the	MASA 7-28-0
	Restraint Cable.	Verify PQAR	4
6.0.5	Photograph set-up.	POAR USO	)_/
6.0.6	Install furnace and heat to 1250F (HT tests only).	Verify PQAR N/A	MASA 7-28-
6.0.7	Begin video.	POA BB	R C
<b>〈</b> 6.0.8	Verify all thermocouples read 1250F +/- 10 degrees	(HT tests only). NA	/NASA 7-28- 4
6.0.9	Document temperature of test article. 73° F	Witness PQAR	R
6.0.10	Ramp load to approximately 45 pounds at a load rate	the state of the s	7-28-0
	inches per minute. 44.9 165	Witness PQAR	
6.0.11	Verify load is at approximately 45 pounds and all inst	rumentation is	7-28-09
	functioning.	Verify PQAR	A
6.0.12	Continue increase load until failure occurs.:	Witness PQAR	)



	ED33 / MECHA	ANICAL METALLURGY A	ND CORROSION TEA	AM	
SRB D	iagonal Strut Restraint Cable Assembly	SRB-QUAL-04-0064	Revis	ion: Basic	
Q	UALIFICATION TEST	Date: 7/26/04	Page	7 of 9	A
5.0.13	Verify load and instru	mentation.	\	Verify PQAR	NASA 7
6.0.14	Stop video.				POAR TO THE POAR
6.0.15	Document load and lo Failure load _/792. Failure location:		_ swage _ inches from ca _ other _ V	ble end erify PQAR	MASA 7
6.0.16	Photograph set-up.				NASA 7
6.0.17	Place broken Restrain	t Cable debris in Zipl		tify. erify PQAR	NASA 7
6.0.18	IF any anomaly or test values, contact the foll Richard Knochelmann Cary Cox (321) 867-1 Pat Roberts (321) 867 Mark Hill (256) 544-43	owing within 24 hour (321) 867-9813 or ( 757 -1757	s: Chris Epler (321)		

ED33 / MECH	ANICAL METALLURGY AND	CORROSION TEAM
RB Diagonal Strut Restraint Cable Assembly	SRB-QUAL-04-0064	Revision: Basic
QUALIFICATION TEST	Date: 7/26/04	Page 6 of 9
TEST OPERATION		
	urrent for all calibrated to 3-WI-012 Mechanical To es	esting Calibration and
		Verify PQAR
test:	r other identification for t	he Restraint Cable in
_Lot 536	9 R1-5	Verify PQAR
.3 Mount the Restraint (	Cable into the fixture.	Verify PQAR
.4 Apply three thermoco Restraint Cable.	uples, one at the top, m	iddle and bottom of the <i>NIA</i> Verify PQAR
.5 Photograph set-up.		<u> </u>
.6 Install furnace and he	at to 1250F (HT tests or	verify PQAR 1
7 Begin video.		
8 Verify all thermocoupl	es read 1250F +/- 10 de	grees (HT tests only). ALA Verify PQAR
9 Document temperatur	re of test article. 7	Witness PQAR
10 Ramp load to approximate.	mately 45 pounds at a lo	ad rate not to exceed-5 Witness PQAR
11 Verify load is at approfunctioning.	ximately 45 pounds and	



Witness PQAR

6.0.12 Continue increase load until failure occurs.:

ED33 / MECH	ANICAL METALLURGY AND CORRO	DSION TEAM
SRB Diagonal Strut Restraint Cable Assembly	SRB-QUAL-04-0064	Revision: Basic
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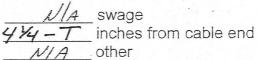
6.0.13 Verify load and instrumentation.



6.0.15 Document load and location of failure:

Failure load 1779, 8

Failure location:



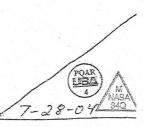
Verify PQAR



6.0.17 Place broken Restraint Cable debris in Ziploc bag and identify.

Verify PQAR

6.0.18 IF any anomaly or test failure occurs below the expected minimum values, contact the following within 24 hours: Richard Knochelmann (321) 867-9813 or Chris Epler (321) 867-9309 Cary Cox (321) 867-1757 Pat Roberts (321) 867-1757 Mark Hill (256) 544-4327 or Brian Pung (256) 544-9346



ED33 / MECHANICAL METALLURGY AND CORROSION TEAM

SRB Diagonal Strut Restraint Cable SRB-QUAL-04-0064 Revision: Basic Assembly QUALIFICATION TEST Date: 7/26/04 Page 6 of 9 6.0 TEST OPERATION Verify calibration is current for all calibrated test equipment in 6.0.1 accordance with ED33-WI-012 Mechanical Testing Calibration and Verification Procedures Verify PQAR Note serial number or other identification for the Restraint Cable in 6.0.2 Lot 5369 Elv-6 Verify PQAR \_\_\_\_\_ 6.0.3 Mount the Restraint Cable into the fixture. Verify PQAR . 6.0.4 Apply three thermocouples, one at the top, middle and bottom of the Restraint Cable. Verify PQAR Photograph set-up. 6.0.5 Install furnace and heat to 1.250F (HT tests only). 6.0.6 Verify PQAR 16.0.7 Begin video. Verify all thermocouples read 1250F +/- 10 degrees (HT tests only). 6.0.8 Verify PQAR Document temperature of test article. \_\_\_/258 6.0.9. Ramp load to approximately 45 pounds at a load rate not to exceed-5 inches per minute. 45.1 /bs Witness PQAR 6.0.11 Verify load is at approximately 45 pounds and all instrumentation is functioning. Verify PQAR 6.0.12 Continue increase load until failure occurs.: Witness PQAR

SRB Diagonal Strut Restraint Cable Assembly QUALIFICATION TEST		SRB-QUAL-04-0064	Revision: Basic
		Date: 7/26/04	Page 7 of 9
6.0.13	Verify load and instru	mentation.	Verify PQAR
6.0.14	Stop video.		
6.0.15	Document load and le Failure load Failure location:	534-T	swage inches from cable end other Verify PQAR
6.0.16	Photograph set-up.		
6.0.17	Place broken Restrain	nt Cable debris in Ziploo	bag and identify.  Verify PQAR
6.0.18	values, contact the for Richard Knochelmann Cary Cox (321) 867-Pat Roberts (321) 86	1757	ris Epler (321) 867-9309
	Charged L	-oad Rate fi 2 IN/mip.	rom 0.02 IN/Min.
	m 198,8	16s. max as	t ord IN/main.
	332,2 /6		Load to Breake
		Sample. Machine	piston out of
		Renge.	

ATTachment #7
ED33/MECHANICAL METALLURGY AND CORROSION TEAM

SRB D	iagonal Strut Restraint Cable	ANICAL METALLURGY AND C SRB-QUAL-04-0064	Revision: Basic	
Q	Assembly UALIFICATION TEST	Date: 7/26/04	Page 6 of 9	
6.0	TEST OPERATION			
5.0.1		urrent for all calibrated te 3-WI-012 Mechanical Te	esting Calibration and	_
	vermoation i recedar		Verify PQAR	28-
5.0.2		r other identification for the	ne Restraint Cable in	
	test: Lot 536	9 E/V-7	POAR NA	SA
			Verify PQAR	70
6.0.3	Mount the Restraint C	Cable into the fixture.	Verify PQAR	7-29
6.0.4	Apply three thermoco Restraint Cable.	uples, one at the top, mi	ddle and bottom of the	
· · · · · · · · · · · · · · · · · · ·	Restraint Cable.		Verify PQAR POAR 7-	-28
6.0.5	Photograph set-up.		FOAR NASS	7-
6.0.6	Install furnace and he	at to 1250F (HT tests on	Verify PQAR	7-28
3.0.7	Begin video.		N/A	
8.0.8	Verify all thermocoupl	es read 1250F +/- 10 de		-85
3.0.9	Document temperatur	e of test article/6	Witness PQAR WASA	₹7-Z
5 <del>.</del> 0.10	Ramp load to approximate inches per minute.	nately 45 pounds at a lo	ad rate not to exceed-5  Witness PQAR	一7-
5.0.11	Verify load is at approfunctioning.	ximately 45 pounds and	all instrumentation is  Verify PQAR  POAR  TO AR  T	28-0
.0.12	Continue increase load	d until failure occurs.:	Witness PQAR (ROAR)	<b>1</b> 4

SRB Di	agonal Strut Restraint Cable	ANICAL METALLURGY AI SRB-QUAL-04-0064	REVISION TEAM  Revision: Basic	
Qī	Assembly UALIFICATION TEST	Date: 7/26/04	Page 7 of 9	*
6.0.13	Verify load and instru	mentation.	Verify PQAR	M. NASA 380
<b>X</b> 6.0.14	Stop video.			NA
6.0.15	Document load and lo Failure load <u>349.</u> Failure location:		_swage	
NOTE.	LOAD RATE 0,8 IN/MIN PER TELECON	5"-T NA	inches from cable end other  Verify PQAR	AR NA SE
6.0.16	Photograph set-up.		POAR LIBERT	NASA 380
6.0.17	Place broken Restrain	it Cable debris in Zipl	oc bag and identify.  Verify PQAR	NASA 380 POAR ISS
6.0.18	values, contact the fol	lowing within 24 hour (321) 867-9813 or ( 757 7-1757	Chris Epler (321) 867-9309	7-28-0

ATTachment #8

	ED33/MECH	ANICAL METALLURGY AND C	ORROSION TEAM
SRB D	iagonal Strut Restraint Cable	SRB-QUAL-04-0064	Revision: Basic
Q	Assembly UALIFICATION TEST	Date: 7/26/04	Page 6 of 9
6.0.1	TEST OPERATION  Verify calibration is consecordance with ED3	urrent for all calibrated te 3-WI-012 Mechanical Te	st equipment in sting Calibration and
	Verification Procedur		Verify PQAR 7-28-04
6.0.2		r other identification for the	ne Restraint Cable in
	test: Lot 50	369 Elv-8	Verify PQAR  Verif
6.0.3	Mount the Restraint 0	Cable into the fixture.	Verify PQAR 7.28-04
6.0.4	Apply three thermoco	uples, one at the top, mid	Verify PQAR
6.0.5	Photograph set-up.		POAR MASA 28-04
6.0.6	Install furnace and he	at to 1250F (HT tests on	y). Verify PQAR (1948) 7-28-04
6.0.7	Begin video.		NA
6.0.8	Verify all thermocoupl	es read 1250F +/- 10 deg	yrees (HT tests only).  Verify PQAR  Verify PQAR
6.0.9	Document temperatur	e of test article	Witness PQAR POAR MASA - 288
6.0.10	Ramp load to approximate.	nately 45 pounds at a load	Witness PQAR  Witness PQAR  Was 28-28-28-28-28-28-28-28-28-28-28-28-28-2
5.0.11	Verify load is at approfunctioning.	ximately 45 pounds and	Verify PQAR POR 7-28
5.0.12	Continue increase load	d until failure occurs.:	Witness PQAR POAR 28 0

ED33 / MECH	ANICAL METALLURGY AND C	ORROSION TEAM
SRB Diagonal Strut Restraint Cable Assembly	SRB-QUAL-04-0064	Revision: Basic
QUALIFICATION TEST	Date: 7/26/04	Page 7 of 9
6.0.13 Verify load and instru	imentation.	Verify PQAR
(6.0.14 Stop video.		MASA ANA 7-
6.0.15 Document load and I Failure load 333 Failure location:		vage
Note: Load Rate  8.8 /m/min  Per Tolecon		ches from cable end her Verify PQAR
6.0.16 Photograph set-up.		POAR MASSA
6.0.17 Place broken Restrai	nt Cable debris in Ziploc l	pag and identify.  Verify PQAR  ROAR  72
6.0.18 IF any anomaly or tes	st failure occurs below the	e expected minimum

values, contact the following within 24 hours:

Mark Hill (256) 544-4327 or Brian Pung (256) 544-9346

Cary Cox (321) 867-1757 Pat Roberts (321) 867-1757

Richard Knochelmann (321) 867-9813 or Chris Epler (321) 867-9309

ED33 / IMECE	ANICAL METALLURGY AND CO	RRUSIUN LEAN
SRB Diagonal Strut Restraint Cable Assembly	SRB-QUAL-04-0064	Revision: Basic
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#### 6.0 TEST OPERATION

6.0.1 Verify calibration is current for all calibrated test equipment in accordance with ED33-WI-012 Mechanical Testing Calibration and Verification Procedures



Verify PQAR Note serial number or other identification for the Restraint Cable in

6.0.2

Verify PQAR

6.0.3 Mount the Restraint Cable into the fixture.

Apply three thermocouples, one at the top, middle and bottom of the 6.0.4 Restraint Cable. Verify PQAR

6.0.5 Photograph set-up.

Install furnace and heat to 1250F (HT tests only). 6.0.6

Verify PQAR



Verify all thermocouples read 1250F +/- 10 degrees (HT tests only). 6.0.8 Verify PQAR

6.0.9 Document temperature of test article.

Witness POAR

Ramp load to approximately 45 pounds at a load rate not to exceed-5 inches per minute.

Witness PQAR



Verify load is at approximately 45 pounds and all instrumentation is 6.0.11 functioning.

Verify PQAR

6.0.12 Continue increase load until failure occurs.:

Witness PQAR



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	QT	Assembly JALIFICATION TEST	Date: 7/26/04	I	Page 7 of 9	
	6.0.13	Verify load and instru	mentation.		Verify PQAR	MASA 380 7-28-01
,	<b>x</b> 6.0.14	Stop video.				D/A
	6.0.15	Document load and lo Failure load <u>330.3</u> Failure location:		_swage		
Note 0.8	: Load	Rath u Per Tetecon	6/4-T	_ inches fron _ other	verify PQAR	POAR MASA 380 7-27-01
	6.0.16	Photograph set-up.			4	(NASA) (138-0)
	6.0.17	Place broken Restrain	nt Cable debris in Zipl	oc bag and i	dentify. Verify PQAR	NASA 380 70AB 7-28-01
	6.0.18	IF any anomaly or tes	t failure occurs helow	the expecte		1-10 of
	0.0.10	values, contact the fol Richard Knochelmann Cary Cox (321) 867-1 Pat Roberts (321) 86 Mark Hill (256) 544-4	lowing within 24 hour (321) 867-9813 or ( 757 7-1757	s: Chris Epler (3	321) 867-9309	7,28 Orl POAR AND

ED33 / MECH	LANICAL METALLURGY AND CO	ORROSION TEAM
SRB Diagonal Strut Restraint Cable Assembly	SRB-QUAL-04-0064	Revision: Basic
QUALIFICATION TEST	Date: 7/26/04	Page 6 of 9

- 6.0 TEST OPERATION
- Verify calibration is current for all calibrated test equipment in 6.0.1 accordance with ED33-WI-012 Mechanical Testing Calibration and Verification Procedures Verify PQAR



Note serial number or other identification for the Restraint Cable in 6.0.2 test:

Lot 5369 Elv-10

Verify PQAR

Mount the Restraint Cable into the fixture. 6.0.3

Verify PQAR

Apply three thermocouples, one at the top, middle and bottom of the 6.0.4 Restraint Cable.

Verify PQAR

- Photograph set-up. 6.0.5
- Install furnace and heat to 1250F (HT tests only). 6.0.6

Verify PQAR

- Begin video. ×6.0.7
  - Verify all thermocouples read 1250F +/- 10 degrees (HT tests only). 6.0.8

Verify PQAR

Document temperature of test article. 6.0.9

Ramp load to approximately 45 pounds at a load rate not to exceed 5 6.0.10 inches per minute. 43.8

Witness PQAR

6.0.11 Verify load is at approximately 45 pounds and all instrumentation is functioning.

Verify PQAR

6.0.12 Continue increase load until failure occurs.:

Witness PQAR





7-28.04

7-28-04



	ED33 / MECH	ANICAL METALLURGY AND CORROS	SION TEAM
SRB Di	agonal Strut Restraint Cable	SRB-QUAL-04-0064	Revision: Basic
Qì	Assembly UALIFICATION TEST	Date: 7/26/04	Page 7 of 9
6.0.13	Verify load and instru	imentation.	Verify PQAR 7-28-04
<b>X</b> 6.0.14	Stop video.		NA
6.0.15	Document load and le Failure load <u>337</u> Failure location:	<b>&amp;</b> swage	
Note: Lo.	ad Rate	<u>5¾-T</u> inches f	from cable end  Verify POAR  Verify POAR  Verify POAR
0.8 1 /min	Per Telecon		Verify PQAR PQAR 7-28
6.0.16	Photograph set-up.		NASA 28-09
6.0.17	Place broken Restrai	nt Cable debris in Ziploc bag ar	nd identify.  Verify PQAR  PQAR  PQAR  7-28-04
6.0.18	values, contact the for Richard Knochelmani Cary Cox (321) 867-Pat Roberts (321) 86		er (321) 867-9309

ATHCHOLENT #1

ED33 / MECH	ANICAL METALLURGY AND COR	CODIOI IEIEI
SRB Diagonal Strut Restraint Cable Assembly	SRB-QUAL-04-0064	Revision: Basic
QUALIFICATION TEST	Date: 7/26/04	Page 6 of 9

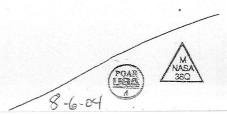
Qu	JALINICATION TEST		
6.0	TEST OPERATION		
6.0.1	Verify calibration is current for all calibrated test equip accordance with ED33-WI-012 Mechanical Testing Ca	ment in alibration and	MASA 38Q
	Verification Procedures	Verify PQAR	3-6-0
6.0.2	Note serial number or other identification for the Restr	aint Cable in	
	test: Lot 07/08/ RT-1	Verify PQAR	POAR 4 8-6-
6.0.3	Mount the Restraint Cable into the fixture.	Verify PQAR	NASA BOAR FOAR 4
<b>6</b> .0.4	Apply three thermocouples, one at the top, middle and	d bottom of the	NA
	Restraint Cable.	Verify PQAR	A
6.0.5	Photograph set-up.		MASA 380
<b>⊀</b> 6.0.6	Install furnace and heat to 1250F (HT tests only).	Verify PQAR	
6.0.7	Begin video.		MASA 8-6
<b>4</b> 6.0.8	Verify all thermocouples read 1250F +/- 10 degrees (F	HT tests only).  Verify PQAR	NA
6.0.9	Document temperature of test article. 76 °F	Witness PQAR	POAR 8-6
6.0.10	Ramp load to approximately 45 pounds at a load rate inches per minute.		NASA 8-60 POAR USA
		Witness PQAR	<u> </u>
6.0.11	Verify load is at approximately 45 pounds and all instructioning. 46 (65	umentation is	NASA 38Q
	/ 6 ( N 5	Verify PQAR	POAR BOOK
6.0.12	Continue increase load until failure occurs.:	Witness PQAR	POAR 3-6-0

	ED33 / MECH	ANICAL METALLURGY AN	O CORROSION TEAM	
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Qī	JALIFICATION TEST	Date: 7/26/04	Page 7 of 9	
6.0.13	Verify load and instru	umentation.	Verify PQAR	NASA 380
6.0.14	Stop video.			NASA
6.0.15	Document load and lead resilure load /95 Failure location:		swage inches from cable end other	738Q PQAR USA
			Verify PQAR	<u> </u>
6.0.16	Photograph set-up.			M NASA 38Q
6.0.17	Place broken Restrai	nt Cable debris in Ziplo	oc bag and identify.  Verify PQAR	38Q MASA 38Q POAR USA
6.0.18	values, contact the for Richard Knochelman Cary Cox (321) 867- Pat Roberts (321) 86	ollowing within 24 hours n (321) 867-9813 or C 1757	hris Epler (321) 867-9309	4

### AHACHMENT #2

ANICAL METALLURGY AND CO	ORROSION TEAM
SRB-QUAL-04-0064	Revision: Basic
Date: 7/26/04	Page 6 of 9

Q	Assembly UALIFICATION TEST	Date: 7/26/04	Page 6 of 9		
6.0	TEST OPERATION				
6.0.1	accordance with ED	current for all calibrated 33-WI-012 Mechanical	test equipment in Festing Calibration and	M NASA 38Q	
	Verification Procedu	ıres	Verify PQAR	(UBA)	40-6-8
6.0.2	Note serial number test:	or other identification for	the Restraint Cable in		
	Lot o	71081 RT-3	Verify PQAR	FOAR	(8-6-04
6.0.3	Mount the Restraint	Cable into the fixture.	Verify PQAR	WASA 3800 3800 3800 3800	8-6-04
<b>¥</b> 6.0.4	Apply three thermoder Restraint Cable.	couples, one at the top, r	middle and bottom of the	S MASA N	A 8-6-04
6.0.5	Photograph set-up.		Verify PQAR	M NASA 38Q	-8-6-04
<del>×</del> 6.0.6	Install furnace and h	neat to 1250F (HT tests of	only). Verify PQAR	NA NA	8-6-04
6.0.7	Begin video.			NASA 380	8-6-04
¥6.0.8	Verify all thermocou	ples read 1250F +/- 10 c	degrees (HT tests only).  Verify PQAR	NA	8-6-04
6.0.9	Document temperate	ure of test article.	767° F Witness PQAR	Con C	8-to-04
6.0.10	Ramp load to approxinches per minute.	ximately 45 pounds at a	load rate not to exceed 5  Witness PQAR	NASA 38G	8-6-04
6.0.11	Verify load is at appr functioning.	oximately 45 pounds an		NASAA 38Q	0-10-04
6.0.12	Continue increase lo	ad until failure occurs.:	Witness PQAR	POAR L	0-11-07
			(1) 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1		8604



	ED33 / MECH	ANICAL METALLURGY AT	ND CORROSIO		
SRB Diz	egonal Strut Restraint Cable Assembly	SRB-QUAL-04-0064		Revision: Basic	
QU	JALIFICATION TEST	Date: 7/26/04		Page 7 of 9	<b>A</b>
6.0.13	Verify load and instru	mentation.		Verify PQAR	NASA 380
6.0.14	Stop video.				NASA 38Q
6.0.15	Document load and le Failure load <u>1954.</u> Failure location:		_ swage _ inches fro _ other	m cable end Verify PQAR	
8.0.16	Photograph set-up.				NASA 38G
6.0.17	Place broken Restrain	nt Cable debris in Zipl	loc bag and	identify. Verify PQAR	NASA 38Q
5.0.18	IF any anomaly or test values, contact the for Richard Knochelmani Cary Cox (321) 867-12 Pat Roberts (321) 868 Mark Hill (256) 544-4	llowing within 24 hour n (321) 867-9813 or ( 1757 7-1757	rs: Chris Epler (	(321) 867-9309	G

### ATTACHMEN+#3

ED33 / MECH	ANICAL METALLURGY AND CORROSI	ON TEAM
SRB Diagonal Strut Restraint Cable Assembly	SRB-QUAL-04-0064	Revision: Basic
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	Assembly				
	QUALIFICATION TEST	Date: 7/26/04	Page 6 of 9		
6.0	TEST OPERATION				
6.0		urrent for all calibrated t 3-WI-012 Mechanical T		M NASA 38Q	
	vermeation riocedur	33	Verify PQAR	POAR UBA	8-6-04
6.0		other identification for	the Restraint Cable in		
	test:	181 RT-3		POAR	T 121
			Verify PQAR	M C	8-6-09
6.0	Mount the Restraint C	Cable into the fixture.	Verify PQAR	NASA 380	8-6-04
¥6.0		uples, one at the top, m	iddle and bottom of the	11/0	
	Restraint Cable.		Verify PQAR	NA	8-6-04
6.0	).5 Photograph set-up.			NASA 380	8-6-09
<b>¥</b> 6.0	.6 Install furnace and he	at to 1250F (HT tests o	nly). Verify PQAR	NA	8-6-04
6.0	.7 Begin video.			NASA 380 2	8-6-04
X6.0	.8 Verify all thermocoupl	es read 1250F +/- 10 de	egrees (HT tests only).  Verify PQAR	N/A	8-6-04
6.0	.9 Document temperatur	e of test article	Witness PQAR		5-6-04
6.0		nately 45 pounds at a lo	pad rate not to exceed 5	NASA 380 L	8-6-04
	inches per minute.		Witness PQAR	POAR LISEA 8	;-G-04
6.0	.11 Verify load is at approx functioning.	47. 6 165	all instrumentation is  Verify PQAR	MASA NASA POAR POAR 8-	-6-04
6.0.	.12 Continue increase load	d until failure occurs.:	Witness PQAR	POAR 3000 A	3-6-04
	The state of the s				



ED33 / MECB	IANICAL METALLURGY AND	CORROSION TEAM	
SRB Diagonal Strut Restraint Cable Assembly	SRB-QUAL-04-0064	Revision: Basic	
QUALIFICATION TEST	Date: 7/26/04	Page 7 of 9	Λ
			NASA 38Q
6.0.13 Verify load and instru	umentation.	Verify PQAR	TOAR LIBEA
5.0.14 Stop video.			NASA 380
.0.15 Document load and	location of failure:		
Failure load /89/ Failure location:	5 (1953.8) Second 1	swage	
ranure location.	374"-T	inches from cable end	POAR
	W/A	other Verify PQAR	
			MASA
6.0.16 Photograph set-up.			NASA 380
6.0.17 Place broken Restra	int Cable debris in Ziplo	c bag and identify.	NASA 380
		Verify PQAR (	PQAR USA
	st failure occurs below t		4
values, contact the fo	ollowing within 24 hours:	: hris Epler (321) 867-9309	
Cary Cox (321) 867-	-1757		1.
Pat Roberts (321) 86	67-1757 4327 or Brian Pung (256		(4

ED33 / MECH	ANICAL METALLURGY AI	ND CORRO	SION TEAM
SRB Diagonal Strut Restraint Cable Assembly	SRB-QUAL-04-0064		Revision: Basic
QUALIFICATION TEST	Date: 7/26/04		Page 6 of 9

	QUALIFICATION TEST	Date: 7/26/04		Page 6 of 9		
6.0	TEST OPERATION					
6.0.1	Verify calibration is cuaccordance with ED3 Verification Procedure	3-WI-012 Mechanic	ted test equip cal Testing C	oment in alibration and Verify PQAR	NASA 380	8-6-04
6.0.2	Note serial number or test:		for the Rest	raint Cable in		
	<u>LoT</u>	07/081	R7-4	Verify PQAR	POAR 1	18-6-04
6.0.3	Mount the Restraint C	able into the fixture	<b>.</b>	Verify PQAR	VASA 380	8-6-04
<del>¥</del> 6.0.4	Apply three thermoco	uples, one at the to	p, middle an	d bottom of the	AIA	
	Restraint Cable.			Verify PQAR	NA MA	8-6-04
6.0.5	Photograph set-up.				380	C8-604
<b>¥</b> 6.0.6	Install furnace and he	at to 1250F (HT tes	sts only).	Verify PQAR	NA	8-6-04
6.0.7	Begin video.				NASA 38Q	8-10-04
<b>£</b> 6.0.8	Verify all thermocoupl	es read 1250F +/-	10 degrees (I	HT tests only). Verify PQAR	NA	8-6-04
6.0.9	Document temperatur	e of test article	709F	Witness PQAR	PQAR USA A	8-le-04
6.0.10	Ramp load to approxir	mately 45 pounds a	at a load rate	not to exceed 5	NASA 380	8604
	inches per minute.			Witness PQAR	POAR	8-6-04
6.0.11	Verify load is at appro-		7 .	umentation is	NASA 380	
	functioning.	4471	65	Verify PQAR	PQAR 188A	8-6-04
6.0.12	Continue increase load	d until failure occur	s.:	Witness PQAR	POAR USA	8604



	ED33 / MECH	ANICAL METALLURGY AND	CORROSION TEAM	1
SRB Di	agonal Strut Restraint Cable Assembly	SRB-QUAL-04-0064	Revision	n: Basic
QŢ	JALIFICATION TEST	Date: 7/26/04	Page 7	of 9
6.0.13	Verify load and instru	imentation.	Ve	nasa erify PQAR POAR
6.0.14	Stop video.			MAS Jast
6.0.15	Failure load _/935. Failure location:	ZNS.de Top s	wage nches from cabl ther Ve	e end rify PQAR
.0.16	Photograph set-up.			NAS.
5.0.17	Place broken Restrain	nt Cable debris in Ziploc		y. AMAS AMAS AMAS AMAS AMAS AMAS AMAS AMAS
5.0.18	values, contact the for Richard Knochelmann Cary Cox (321) 867-1 Pat Roberts (321) 86		is Epler (321) 8	

SRB Diagonal Strut Restraint Cable	ANICAL METALLURGY AND C	Revision: Basic	
Assembly			
QUALIFICATION TEST	Date: 7/26/04	Page 6 of 9	

Qī	UALIFICATION TEST	Date: 7/26/04		rage o or >	
6.0	TEST OPERATION				
6.0.1	accordance with ED3	current for all calibrated 33-WI-012 Mechanica	d test equip I Testing Ca	ment in alibration and	NASA 38Q
	Verification Procedur	res		Verify PQAR	FOAR _
6.0.2		or other identification for	or the Restr	raint Cable in	
	test: LoT C	57/081 87-	-5	Verify PQAR	POAR 4
	Manual Clas Destroint	Cable into the fixture.			M NASA 38Q
6.0.3	Mount the Restraint	Sable into the fixture.		Verify PQAR	POAR LEG
<b>¥</b> 6.0.4		ouples, one at the top,	, middle and	d bottom of the	N/A
	Restraint Cable.			Verify PQAR	N/A 8-6-
6.0.5	Photograph set-up.				/NASA 87
<del>₹</del> 6.0.6	Install furnace and h	eat to 1250F (HT tests	s only).	Verify PQAR	N/A 8-6-E
6.0.7	Begin video.				NASA 380
<b>¥</b> 6.0.8	Verify all thermocoup	oles read 1250F +/- 10	) degrees (H	HT tests only): Verify PQAR	N/A 8-6
6.0.9	Document temperatu	re of test article	71°F	Witness PQAR	POAR 18-6
6.0.10		imately 45 pounds at	a load rate	not to exceed 5	MASA 380
	inches per minute.			Witness PQAR	POAR 8-6
6.0.11		oximately 45 pounds a	and all instru	umentation is	MASA 38Q
	functioning.	47.4 lbs		Verify PQAR	POAR 8-10
6.0.12	Continue increase los	ad until failure occurs.		Witness PQAR	POAR USA 4



	ग्रा १४ १० तस	ANICAL METALLURGY AND (	CORROSION TEAM	
SRB Di	agonal Strut Restraint Cable	SRB-QUAL-04-0064	Revision: Basic	
QŢ	Assembly JALIFICATION TEST	Date: 7/26/04	Page 7 of 9	
6.0.13	Verify load and instru	mentation.	Verify PQAR	NASA 380 8-6-04
6.0.14	Stop video.			NASA 8-6-04
6.0.15	Document load and lo Failure load / 935. Failure location:	INS: de TOP s	wage nches from cable end ther Verify PQAR	8-6-09
6.0.16	Photograph set-up.			MASA 1876-00
6.0.17	Place broken Restrain	nt Cable debris in Ziploc	bag and identify.  Verify PQAR	NASA BEG 1004 4 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
6.0.18	values, contact the fo Richard Knochelmani Cary Cox (321) 867- Pat Roberts (321) 86	1757	ris Epler (321) 867-9309	POAR MASA 380

ATTAChnewi #6

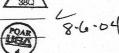
SRB Diagonal Strut Restraint Cable	ANICAL METALLURGY AND CORRO SRB-QUAL-04-0064	Revision: Basic
Assembly OUALIFICATION TEST	Date: 7/26/04	Page 6 of 9

		COPPATION
6.0	TEST	OPERATION
		OI LIUTIOI.

Verify calibration is current for all calibrated test equipment in 6.0.1 accordance with ED33-WI-012 Mechanical Testing Calibration and Verification Procedures



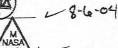
Verify PQAR



Note serial number or other identification for the Restraint Cable in 6.0.2

ot 07/081 Elu-6

Verify PQAR



Mount the Restraint Cable into the fixture. 6.0.3

Apply three thermocouples, one at the top, middle and bottom of the 6.0.4 Restraint Cable.

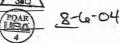
Verify PQAR

Photograph set-up. 6.0.5

Install furnace and heat to 1250F (HT tests only).

08-6-04

Verify PQAR

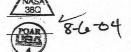


Begin video. X6.0.7.

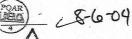
6.0.6

Verify all thermocouples read 1250F +/- 10 degrees (HT tests only): 6.0.8

Verify PQAR

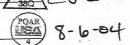


Document temperature of test article. 1351 ° F 6.0.9



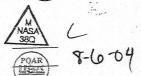
Ramp load to approximately 45 pounds at a load rate not to exceed 5 6.0.10 inches per minute.

Witness PQAR



6.0.11 Verify load is at approximately 45 pounds and all instrumentation is functioning. 46.2 165

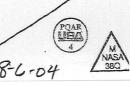
Verify PQAR



6.0.12 Continue increase load until failure occurs.:

Witness PQAR





	ED33 / MECH	ANICAL METALLURGY AI	VD CORROSI	ON TEAM	
SRB Di	agonal Strut Restraint Cable Assembly	SRB-QUAL-04-0064		Revision: Basic	•
QT	JALIFICATION TEST	Date: 7/26/04		Page 7 of 9	A
6.0.13 6.0.14	Verify load and instru	mentation.		Verify PQAR	MASA 380 POAR 1854 4 N/A
6.0.15	Document load and lead load lead lead lead lead lead lead lead le		_ swage _ inches fr _ other	om cable end Verify PQAR	POAR LAND C & LO-CK
6.0.16	Photograph set-up.				1389A (8-60
6.0.17	Place broken Restrai	nt Cable debris in Zip	loc bag an	d identify. Verify PQAR	POAR 8-6-0
6.0.18	Cary Cox (321) 867- Pat Roberts (321) 86	Nowing within 24 hou n (321) 867-9813 or 1757	rs: Chris Eple	r (321) 867-9309	POAR MASA SBO SBO

ED33 / MECH	ANICAL METALLURGY AND C	ORROSION TEAM
SRB Diagonal Strut Restraint Cable Assembly	SRB-QUAL-04-0064	Revision: Basic
QUALIFICATION TEST	Date: 7/26/04	Page 6 of 9

Q	UALIFICATION TEST	Date. 1120104		
6.0	TEST OPERATION			
6.0.1	Verify calibration is cu accordance with ED33 Verification Procedure	irrent for all calibrated test 3-WI-012 Mechanical Tes es	ting Calibration and Z	NASA 380 8-6-0
			Verify PQAR	( )
6.0.2	tact.	other identification for the	e Restraint Cable in	POAR LESS
	_ 601 0110	181 Elv-7	Verify PQAR	~ ~ 8-6.
6.0.3	Mount the Restraint C	able into the fixture.	Verify PQAR	NASA 380 POAR 8-6
6.0.4	Apply three thermocou	uples, one at the top, mide		NASA 380 8-6-
			Verify PQAR	TASA .
6.0.5	Photograph set-up.			380 C 8-(
6.0.6	Install furnace and hea	at to 1250F (HT tests only	Verify PQAR I	ANSA 380 POAR USA 4
<b>4</b> 6.0.7	Begin video.			MA
6.0.8	Verify all thermocouple	es read 1250F +/- 10 degr	rees (HT tests only): Verify PQAR	NASA 38Q POAR 8-6-1
6.0.9	Document temperature	e of test article. /35	Witness PQAR	OAR 28-6
6.0.10	Ramp load to approxin inches per minute.	nately 45 pounds at a load		NASA 380 8-6
			Witness PQAR	8-6.
6.0.11	Verify load is at approx functioning.	imately 45 pounds and al	Il instrumentation is  Verify PQAR	MASA 380 380 8-6
6.0.12	Confinue increase load	I until failure occurs.:	Witness PQAR	POAR USA



	ED33 / MECH	ANICAL METALLURGY AND C	ORROSION TEAM
SRB Dia	agonal Strut Restraint Cable Assembly	SRB-QUAL-04-0064	Revision: Basic
QT	JALIFICATION TEST	Date: 7/26/04	Page 7 of 9
6.0.13	Verify load and instru	imentation.	Verify PQAR POAR 8-6
6.0.14	Stop video.		N/A 8-C
6.0.15	Document load and I Failure load 383., Failure location:	$\frac{\sqrt{A}}{6.0^{\circ}-T}$ ir	wage ches from cable end her Verify PQAR
6.0.16	Photograph set-up.		MASSA 38C
6.0.17	Place broken Restrai	nt Cable debris in Ziploc	bag and identify.  Verify PQAR  POAR  POAR  VERIFY
6.0.18	values, contact the for Richard Knochelman Cary Cox (321) 867- Pat Roberts (321) 86		is Epler (321) 867-9309

## Attachment 5

SRB Diagonal Strut Restraint Cable	ANICAL METALLURGY AND CORR SRB-QUAL-04-0064	Revision: Basic
Assembly QUALIFICATION TEST	Date: 7/26/04	Page 6 of 9

Qī	UALIFICATION TEST	Date: 7/26/04	Page 6 of 9	
6.0	TEST OPERATION			
6.0.1	Verify calibration is cu accordance with ED33 Verification Procedure	urrent for all calibrated test eq 3-WI-012 Mechanical Testing es	quipment in Quipme	\\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\ \\
6.0.2	test.	r other identification for the Re		10001
	<u>Lo7</u> (	07/08/ 5/1-8	Verify PQAR	_ C8-6-01
6.0.3	Mount the Restraint C	Cable into the fixture.	Verify PQA	86-04
6.0.4	Apply three thermocou Restraint Cable.	ruples, one at the top, middle a	and bottom of the  Verify PQAR	8-6-04
6.0.5	Photograph set-up.		MANA STATE	4 -8-6-0
6.0.6	Install furnace and hea	eat to 1250F (HT tests only).	Verify PQAR	- C8-6-0r
<b>4</b> 6.0.7	Begin video.		NA	1
6.0.8	Verify all thermocouple	les read 1250F +/- 10 degrees	s (HT tests only):  Verify PQAR	28604
6.0.9	Document temperature	re of test article. /2.5	Witness PQAR	2AR 4 (8-6-04
6.0.10	Ramp load to approxing inches per minute.	mately 45 pounds at a load ra	witness PQAR	8-6-04
6.0.11		ximately 45 pounds and all ins	verify PQAR	8-6-04
6.0.12	Continue increase load	d until failure occurs.:	Witness PQAR	86-04

	ED33 / MECH	ANICAL METALLURGY AND CO	DRROSION TEAM	
SRB Diagonal Strut Restraint Cable Assembly QUALIFICATION TEST		SRB-QUAL-04-0064	Revision: Basic	
		Date: 7/26/04	Page 7 of 9	
6.0.13	Verify load and instru	imentation.	Verify PQAR	8-6-C
6.0.14	Stop video.			MA
6.0.15	Document load and I Failure load 386, Failure location:	8/65 NA SW 6.07-T inc	vage ches from cable end ner Verify PQAR	(8-6)
6.0.16	Photograph set-up.			NASA NASA
5.0.17	Place broken Restrai	nt Cable debris in Ziploc b	pag and identify. Verify PQAR	380 L POAR 8-6-
6.0.18	values contact the fo			FOAR NA NA 38

## Attachment II 9

RB Diagonal Strut Restraint Cable Assembly	SRB-QUAL-04-0064	Revision: Basic
QUALIFICATION TEST	Date: 7/26/04	Page 6 of 9

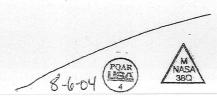
	QĮ	Assembly UALIFICATION TEST	Date: 7/26/04	Pa	ge 6 of 9		
	6.0	TEST OPERATION					
	6.0.1	Verify calibration is cu accordance with ED33 Verification Procedure	rrent for all calibrated to 3-WI-012 Mechanical T	est equipme esting Calib	ent in oration and	M NASA 38Q	
		Vermoation Frocedure			Verify PQAR		8-4-04
	6.0.2		other identification for	the Restrair	nt Cable in		
		test: LoT or	7/081 5/2-9		1/if , DOAD	(484)	
					Verify PQAR		8604
	6.0.3	Mount the Restraint C	able into the fixture.		Verify PQAR	NASA 380	8-6-04
	6.0.4	Apply three thermocou	uples, one at the top, m	niddle and b	ottom of the	NASA C	
	1	Restraint Cable.			Verify PQAR		8-6-04
	6.0.5	Photograph set-up.				NASA 380	8-6-04
	6.0.6	Install furnace and hea	at to 1250F (HT tests o	nly).	Verify PQAR	NASA 380-1	8-6-04
*	<b>4</b> 6.0.7	Begin video.				NA	
	6.0.8	Verify all thermocouple	es read 1250F +/- 10 de	egrees (HT	tests only): Verify PQAR	WASA 380	8-6-04
	6.0.9	Document temperature	e of test article/	258 °/=	Vitness PQAR	POAR POAR	8-6-04
	6.0.10	Ramp load to approxin inches per minute.	nately 45 pounds at a la	oad rate no	t to exceed 5	NASA 380	8-6-04
				V	Vitness PQAR	A A	8-4-04
	6.0.11	Verify load is at approx functioning.	imately 45 pounds and 44 165	d all instrum	entation is Verify PQAR	NASA 38Q PQAR	t-6-04
	6.0.12	Continue increase load		٧	Vitness PQAR	POAR	8-6-04

	ED33 / MECH	ANICAL METALLURGY AND	CORROSION TEAM	
SRB Dia	agonal Strut Restraint Cable Assembly	SRB-QUAL-04-0064	Revision: Basic	
QT	JALIFICATION TEST	Date: 7/26/04	Page 7 of 9	A
6.0.13	Verify load and instru	mentation.	Verify PQAR	MASA 38Q PQAR 4
6.0.14	Stop video.			NA
6.0.15	Document load and le Failure load <u>358</u> Failure location:	.0 4 % "-T	swage inches from cable end	
		_ N / A	other Verify PQAR	POAR 4 NASA
3.0.16	Photograph set-up.			NASA
5.0.17	Place broken Restrai	nt Cable debris in Ziplo	c bag and identify. Verify PQAR	NASA 380 POAR USA
6.0.18	values, contact the for Richard Knochelman Cary Cox (321) 867- Pat Roberts (321) 86	1757	: hris Epler (321) 867-9309	PQAR LESA 4

AMACHMENT # 10

ED33 / MECH	ROSION TEAM	
SRB Diagonal Strut Restraint Cable Assembly	SRB-QUAL-04-0064	Revision: Basic
QUALIFICATION TEST	Date: 7/26/04	Page 6 of 9

Q	QUALIFICATION TEST	Date: 7/26/04	Page 6 of 9	
6.0	TEST OPERATION			
6.0.1	Verify calibration is cuaccordance with ED3: Verification Procedure	urrent for all calibrated test equip 3-WI-012 Mechanical Testing C es	pment in Calibration and Verify PQAR	MM NASA 380 8-6-04
6.0.2		other identification for the Rest	traint Cable in	シ
	test: LoT 0	07/081 E/V-1	O Verify PQAR	POAR 8-6-04
6.0.3	Mount the Restraint C	able into the fixture.	Verify PQAR	MASA 38Q PDAR LISA
6.0.4	Apply three thermocou Restraint Cable.	uples, one at the top, middle an	verify PQAR	NASA POAR POAR 1850
6.0.5	Photograph set-up.		-	1 8-6-E
6.0.6	Install furnace and hea	at to 1250F (HT tests only).	Verify POAR FO	NASA 380 AR
<b>¥</b> 6.0.7	Begin video.		-	NA
6.0.8	Verify all thermocouple	es read 1250F +/- 10 degrees (l	HT tests only): Verify PQAR	MASA 380 FOAR USA
6.0.9	Document temperature	e of test article. /2 40 °	Witness PQAR	
6.0.10	Ramp load to approxing inches per minute.	nately 45 pounds at a load rate	not to exceed 5 Z	MASA 380 POAR USA 4
6.0.11	Verify load is at approx functioning.	ximately 45 pounds and all instr 43.5 /6s	rumentation is  Verify PQAR	MASA 380 POAR LESO
6.0.12	Continue increase load	duntil failure occurs.:	Witness PQAR (	POAR 18-6-04



SRB Diagonal Strut Restraint Cable	SRB-QUAL-04-0064	Revision: Basic
Assembly OUALIFICATION TEST	Date: 7/26/04	Page 7 of 9

6.0.13 Verify load and instrumentation.



¥6.0.14 Stop video.

6.0.15 Document load and location of failure:

Failure load 361. 3 165

Failure location:

swage inches from cable end other

Verify PQAR

6.0.16 Photograph set-up.

6.0.17 Place broken Restraint Cable debris in Ziploc bag and identify.

Verify PQAR

6.0.18 IF any anomaly or test failure occurs below the expected minimum values, contact the following within 24 hours: Richard Knochelmann (321) 867-9813 or Chris Epler (321) 867-9309 Cary Cox (321) 867-1757 Pat Roberts (321) 867-1757 Mark Hill (256) 544-4327 or Brian Pung (256) 544-9346

### attachment # 1

	ANICAL METALLURGY AND CO	Daminian Pagia
SRB Diagonal Strut Restraint Cable	SRB-QUAL-04-0064	Revision: Basic
Assembly		
	Date: 7/26/04	Page 6 of 9
QUALIFICATION TEST	Date: 1120104	2-5
점점 경기 경기 시간 경기 경기 등에 살아 있다면 되었다.		

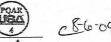
		and the second s
0 0	TEOT	OPERATION
6.0	1-51	LIPERALITIN
U.U	1 _ 0 1	OI LIUITION

Verify calibration is current for all calibrated test equipment in 6.0.1 accordance with ED33-WI-012 Mechanical Testing Calibration and Verification Procedures

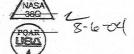


Verify PQAR

Note serial number or other identification for the Restraint Cable in 6.0.2 test: 107 104236

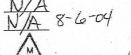


Mount the Restraint Cable into the fixture. 6.0.3



Apply three thermocouples, one at the top, middle and bottom of the £6.0.4 Restraint Cable.

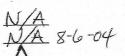
Verify PQAR N



Photograph set-up. 6.0.5

Install furnace and heat to 1250F (HT tests only). ¥6.0.6

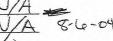
Verify PQAR A



Begin video. 6.0.7

Verify all thermocouples read 1250F +/- 10 degrees (HT tests only): ¥6.0.8

Verify PQAR



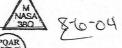
Document temperature of test article. \_ 6.0.9



Ramp load to approximately 45 pounds at a load rate not to exceed 5 6.0.10

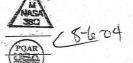
inches per minute.

Witness PQAR



Verify load is at approximately 45 pounds and all instrumentation is 47.8/65 functioning.

Verify PQAR



6.0.12 Continue increase load until failure occurs.:

Witness PQAR





	TO THE COURT	ANICAL METALLURGY AND CO	ORROSION TEAM	
SRB Diz	egonal Strut Restraint Cable Assembly	SRB-QUAL-04-0064	Revision: Basic	
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6.0.13	Verify load and instru	imentation.	Verify PQAR	8-6-04
5.0.14	Stop video.		MASA 38Q	£86-00
6.0.15	Document load and I Failure load _1900. Failure location:	<u>Inside To P</u> sv <u>N/A</u> inc	vage ches from cable end her Verify PQAR	V.8-6-64
6.0.16	Photograph set-up.		MASA 3821 NASA	~8-6-0
6.0.17	Place broken Restra	int Cable debris in Ziploc l	pag and identify.  Verify PQAR  POAR  1801	8-6-01
6.0.18	values, contact the for Richard Knochelman Cary Cox (321) 867- Pat Roberts (321) 8	st failure occurs below the ollowing within 24 hours: in (321) 867-9813 or Chri -1757 67-1757 4327 or Brian Pung (256)	s Epler (321) 867-9309	AR MASA 38Q

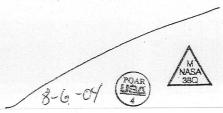
### ATTAChment #Z

ED33 / INECTI	ANICAL METALLURGY AND CO	D. Paris
SRB Diagonal Strut Restraint Cable	SRB-QUAL-04-0064	Revision: Basic
Assembly OUALIPICATION TEST	Date: 7/26/04	Page 6 of 9

	QU	Assembly ALIFICATION TEST	Date: 7/26/04	Page 6 of 9	
	6.0	EST OPERATION			
	6.0.1	accordance with ED33 Verification Procedure		Verify PQAR	MASA 38Q 3-6-€ 4
	6.0.2		other identification for the Rest	raint Cable in	
		test: LoT 10	4236 RT-2	. Verify PQAR	POAR 8-6-0
E	<b>2</b> 6.0.3	Mount the Restraint C	able into the fixture.	Verify PQAR	1380 g-6-0
4	<b>6</b> .0.4	Apply three thermocon Restraint Cable.	uples, one at the top, middle an	Verify PQAR	NA -8-6-01
	6.0.5	Photograph set-up.			NASA 8-6-0
ł	<b>4</b> 6.0.6	Install furnace and he	at to 1250F (HT tests only).	Verify PQAR	NA «
	6.0.7	Begin video.			MASA 28-60 Y
,	<b>¥</b> 6.0.8	Verify all thermocouple	es read 1250F +/- 10 degrees (	HT tests only): Verify PQAR	Ma-
	6.0.9	Document temperatur	e of test article. 7, F	Witness PQAR	POAR 8-6-04
	6.0.10	Ramp load to approximate inches per minute.	mately 45 pounds at a load rate	not to exceed-5 Witness PQAR	NASA 880 8-6-0 POAR 1880
	6.0.11	Verify load is at appro- functioning.	ximately 45 pounds and all instr 47. 4 //s	rumentation is  Verify PQAR	MASA 380 8-6-04

6.0.12 Continue increase load until failure occurs.:

Witness PQAR POAR 49-6-04



ED33 / MECH	ANICAL METALLURGY AND C	ORROSION TEAM
SRB Diagonal Strut Restraint Cable Assembly	SRB-QUAL-04-0064	Revision: Basic
QUALIFICATION TEST	Date: 7/26/04	Page 7 of 9
5.0.13 Verify load and instru	umentation.	Verify PQAR
5.0.14 Stop video.		MASA 38Q
5.0.15 Document load and I Failure load //863.3 Failure location:	761-T ir	Peak Load wage sches from cable end ther  Verify PQAR
6.0.16 Photograph set-up.		<u> </u>
6.0.17 Place broken Restrai	nt Cable debris in Ziploc	bag and identify.  Verify PQAR
values, contact the for Richard Knochelman Cary Cox (321) 867- Pat Roberts (321) 86		is Epler (321) 867-9309

8-6-04 PQAR 1584

## Attachment 3

SRB Diagonal Strut Restraint Cable Assembly	SRB-QUAL-04-0064	Revision: Basic
QUALIFICATION TEST	Date: 7/26/04	Page 6 of 9

Q	Assembly QUALIFICATION TEST	Date: 7/26/04	Page 6 of 9	
6.0	TEST OPERATION			
6.0.1	Verify calibration is accordance with ED Verification Procedu	current for all calibrated 33-WI-012 Mechanical	test equipment in Testing Calibration and	M NASA 38Q
	vermoation	1100	Verify PQAR	8-6-04
6.0.2		or other identification for	r the Restraint Cable in	
	test: 107	104236 RT-	Verify PQAR	Red Sclon
<b>\$</b> 6,0.3	Mount the Restraint	Cable into the fixture.	Verify PQAR	MASA SEO POAR POAR SEO
¥ 6.0.4	Apply three thermoon Restraint Cable.	couples, one at the top, r	middle and bottom of the Verify PQAR	N/A 8-6-C
6.0.5	Photograph set-up.			NASA 380 8-60
¥6.0.6	Install furnace and h	neat to 1250F (HT tests	only). Verify PQAR	N/A 8-6-0
6.0.7	Begin video.			NASA 86
<b>*</b> 6.0.8	Verify all thermocou	ples read 1250F +/- 10 c	degrees (HT tests only): Verify PQAR	NA
6.0.9	Document temperat	ure of test article.	7/° F Witness PQAR	POAR SO
6.0.10	Ramp load to appro- inches per minute.	ximately 45 pounds at a	load rate not to exceed 5  Witness PQAR	MASSA 380 POAR UBA
6.0.11		roximately 45 pounds an		NASA 38Q
	functioning.	47.4	Verify PQAR	F0-00
6,0.12	Continue increase lo	ad until failure occurs.:	Witness PQAR	POAR LISA 4 8-6-0



	TROO (ACECUT	ANICAL METALLURGY AND CO	DRROSION TEAM	
SRB Dia	ED33 / MECH agonal Strut Restraint Cable	SRB-QUAL-04-0064	Revision: Basic	
Assembly QUALIFICATION TEST		Date: 7/26/04	Page 7 of 9	
3.0.13	Verify load and instru	mentation.	Verify PQAR PQAR 8-6	, ~
6.0.14	Stop video.		NASA 8-6	d
6.0.15	Document load and lead Failure load _/899. Failure location:	$\frac{\sqrt{A}}{35^{4}-7}$ in	vage ches from cable end her  Verify PQAR	Q-0
6.0.16	Photograph set-up.		380 S	6-1
6.0.17	Place broken Restra	int Cable debris in Ziploc	pag and identify.  Verify PQAR  POAR  4	6-
6.0.18	values, contact the for Richard Knochelmar Cary Cox (321) 867-Pat Roberts (321) 8	st failure occurs below the bllowing within 24 hours: in (321) 867-9813 or Chr 1757 67-1757 4327 or Brian Pung (256)	s Epler (321) 867-9309	NAS 38

Attachment ## 4

EUSS / INTECT	ANICAL METALLURGY AND CO	
SRB Diagonal Strut Restraint Cable Assembly	SRB-QUAL-04-0064	Revision: Basic
QUALIFICATION TEST	Date: 7/26/04	Page 6 of 9

		A constitue			
	Q <sup>1</sup>	Assembly UALIFICATION TEST	Date: 7/26/04	Page 6 of 9	
	6.0	TEST OPERATION			
	6.0.1	Verify calibration is considered accordance with ED3 Verification Procedure	urrent for all calibrated te 3-WI-012 Mechanical Te es	st equipment in sting Calibration and Verify PQAR	NASA 38Q POAR 8-L-DC
	6.0.2		other identification for the	ne Restraint Cable in	
		test: 207 /	04236 RT-4	Verify PQAR	FOAR (1850) 8-6-04
	6.0.3	Mount the Restraint (	Cable into the fixture.	Verify PQAR	MASA 380 LISA 8-12-04
7	<b>¥</b> 6.0.4	Apply three thermocon Restraint Cable.	uples, one at the top, mid	ddle and bottom of the Verify PQAR	N/A 8-6-04
	6.0.5	Photograph set-up.			NASA 8-6-04
7	<b>¥</b> 6.0.6	Install furnace and he	at to 1250F (HT tests on	ly). Verify PQAR	MA
	6.0.7	Begin video.			MASA 8-6-04
k	<b>6</b> .0.8	Verify all thermocoup	es read 1250F +/- 10 dec	grees (HT tests only):  · Verify PQAR	NA
	6.0.9	Document temperatur	re of test article.	7/ F Witness PQAR	POAR 18-6-04
	6.0.10		mately 45 pounds at a loa	ad rate not to exceed 5	MASA 8-6-09
		inches per minute.		Witness PQAR	POAR 154 8-6-04
	6.0.11	Verify load is at approfunctioning.	ximately 45 pounds and 48.6 (65	all instrumentation is  Verify PQAR	MASA 38Q POAR 4
	6.0.12	Continue increase loa	d until failure occurs.:	50.5	67 W

Witness PQAR PQAR



		ANICAL METALLURGY AND	Revision: Basic	
SRB Diagonal Strut Restraint Cable Assembly QUALIFICATION TEST		SRB-QUAL-04-0064	Revision. Basic	
		Date: 7/26/04	Page 7 of 9	
				M
6.0.13	Verify load and instru	mentation.	V	NASA 38Q
			Verify PQAR	
6.0.14	Stop video.			NAS 380
0.0				
6.0.15	Document load and I Failure load 2008		(*	
	Failure location:	NA	swage	
			nches from cable end	POAR
		NA	other Verify PQAR	
				MASA
6.0.16	Photograph set-up.			380
6.0.17	Place broken Restrai	nt Cable debris in Ziploc	bag and identify.	NASA 38Q
0.0.17	1 1doc broken reservi		Verify PQAR	POAR
0.0.40	**************************************	st failure occurs below th	a expected minimum	4
6.0.18	values, contact the fo	Illowing within 24 hours:	c expedied manificant	
	Richard Knochelman	n (321) 867-9813 or Ch	ris Epler (321) 867-9309	/.
	Cary Cox (321) 867-			(U
	Pat Roberts (321) 86 Mark Hill (256) 544-4	327 or Brian Pung (256	544-9346	01-1
				8-(

8-6-04

Attachment #5

ED33 / MECH	ANICAL METALLURGY AND CO	Old(ObiOl/ lblaid
SRB Diagonal Strut Restraint Cable	SRB-QUAL-04-0064	Revision: Basic
Assembly QUALIFICATION TEST	Date: 7/26/04	Page 6 of 9

Qī	UALIFICATION TEST	Date: 7/26/04	Page 6 of 9	
6.0	TEST OPERATION			
6.0.1	accordance with ED3:	urrent for all calibrated 3-WI-012 Mechanical	test equipment in Festing Calibration and	NASA 38Q
	Verification Procedure	es	Verify PQ	AR 8-6-04
6.0.2	to of:		the Restraint Cable in	
	Lol 1	04236 R1	Verify PC	AR (184) 8-4-04
6.0.3	Mount the Restraint C	cable into the fixture.	Verify PC	MASA NASA 380 AR POAR 8-6-04
<b>¥</b> 6.0.4	Apply three thermocon Restraint Cable.	uples, one at the top, r	niddle and bottom of th	NI
	Restraint Gable.		Verify PC	AR WA
6.0.5	Photograph set-up.			380 28-6-04
<b>¥</b> 6.0.6	Install furnace and he	at to 1250F (HT tests o	only). Verify PG	M
6.0.7	Begin video.			1 380 S-6-00
<b>¥</b> 6.0.8	Verify all thermocoupl	es read 1250F +/- 10 d	degrees (HT tests only) Verify PC	AR NA
6.0.9	Document temperatur	e of test article	71°F Witness PQ	^
6.0.10	Ramp load to approxi	mately 45 pounds at a	load rate not to exceed Witness PQ	870-04
6.0.11	Verify load is at appro	ximately 45 pounds ar	nd all instrumentation is	MASA NASA 380 91004
	functioning.	48.1 165	Verify PQ	2 380 1 , 8 60 0 9
6.0.12	Continue increase loa	d until failure occurs.:	Witness PQ	AR FOAR Story



	ED33 / MECH	ANICAL METALLURGY AND	CORROSION TEAM	
SRB Di:	agonal Strut Restraint Cable Assembly	SRB-QUAL-04-0064	Revision: Basic	
QUALIFICATION TEST		Date: 7/26/04	Page 7 of 9	
6.0.13	Verify load and instru	mentation.	Verify PQAR	M NASA 38Q
6.0.14	Stop video.		4	NASA 38G
6.0.15	Document load and le Failure load 1981.6 Failure location:	165 8/4-7 ii	swage nches from cable end other Verify PQAR	POAR USA
6.0.16	Photograph set-up.			NASA 380
6.0.17	Place broken Restrai	nt Cable debris in Ziploc	bag and identify.  Verify PQAR	PGAR
6.0.18	values, contact the for Richard Knochelman Cary Cox (321) 867- Pat Roberts (321) 86	1757	ris Epler (321) 867-9309	POAR LIBER

Attachment#6

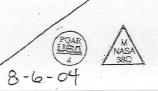
ED33 / MECHANICAL METALLURGY AND CORROSION TEAM						
SRB Diagonal Strut Restraint Cable	SRB-QUAL-04-0064	Revision: Basic				
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### 6.0 TEST OPERATION

6.0.1 Verify calibration is current for all calibrated test equipment in accordance with ED33-WI-012 Mechanical Testing Calibration and Verification Procedures



	Verification Procedures	Verify PQAR	POAR LESA	8-6-04
6.0.2	Note serial number or other identification for the Rest	raint Cable in		
	test: LoT 104236 = E/L-6	Verify PQAR	POAR LIBAT	8-6-04
6.0.3	Mount the Restraint Cable into the fixture.	Verify PQAR	NASA 380 POAR EBSA	8-6-04
6.0.4	Apply three thermocouples, one at the top, middle and	d bottom of the	NASA 38Q	
	Restraint Cable.	Verify PQAR		8-6-04
6.0.5	Photograph set-up.		NASA 38Q	C8-6-04
6.0.6	Install furnace and heat to 1250F (HT tests only).	Verify PQAR	NASA 38Q PQAR	8-6-04
¥6.0.7·	Begin video.		NA	
6.0.8	Verify all thermocouples read 1250F +/- 10 degrees (F	HT tests only): Verify PQAR	NASA 380 PQAR	8-6-04
6.0.9	Document temperature of test article	Witness PQAR	POAR USE A	6-6-04
6.0.10	Ramp load to approximately 45 pounds at a load rate inches per minute.		NASA 380 POAR USA	18-6-04
		Witness PQAR	<u></u>	3-6-04
6.0.11	Verify load is at approximately 45 pounds and all instru	umentation is	NASA	
	functioning. 44.7	Verify PQAR	POAR 1188A 4	8-6-04
6.0.12	Continue increase load until failure occurs.:	Witness PQAR	POAR USA 4	8-6-04



		ANICAL METALLURGY AN	D CURRUSION I LAIM
SRB Di	agonal Strut Restraint Cable Assembly	SRB-QUAL-04-0064	Revision: Basic
QT	JALIFICATION TEST	Date: 7/26/04	Page 7 of 9
6.0.13 6.0.14	Verify load and instru	imentation.	Verify PQAR  POAR  A  A  A  A  A  A  A  A  A
6.0.15	Document load and I Failure load	ocation of failure:  1.8/bs  N/A  S.0 -T  N/A	swage inches from cable end other  Verify PQAR
6.0.16	Photograph set-up.		NASA)
6.0.17	Place broken Restrai	nt Cable debris in Ziplo	oc bag and identify.  Verify PQAR  PQAR  PQAR  PQAR  A
6.0.18	values, contact the for Richard Knochelmani Cary Cox (321) 867- Pat Roberts (321) 86	llowing within 24 hours n (321) 867-9813 or C 1757	hris Epler (321) 867-9309

## ATTachment #7

ED33 / MECHANICAL METALLURGY AND CORROSION TEAM					
SRB-QUAL-04-0064	Revision: Basic				
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	SRB-QUAL-04-0064				

Q	UALIFICATION TEST	Date: 7/26/04	Page 6 of 9	
6.0	TEST OPERATION			
6.0.1	Verify calibration is cuaccordance with ED3: Verification Procedure	irrent for all calibrated test equip 3-WI-012 Mechanical Testing C es	oment in alibration and Verify PQAR	8-6-04
6.0.2	toot:	other identification for the Rest $36 \frac{E/v-7}{}$	verify PQAR	18-6-04
6.0.3	Mount the Restraint C	able into the fixture.	Verify PQAR	<u>1</u> 8-6-04
6.0.4	Apply three thermocol Restraint Cable.	uples, one at the top, middle an	d bottom of the  Verify PQAR  PQAR  Verify PQAR	8-6-04
6.0.5	Photograph set-up.		NASA 380	168-6-04
6.0.6	Install furnace and he	at to 1250F (HT tests only).	Verify PQAR	18-6-04
6.0.7	Begin video.		N	<del></del>
6.0.8	Verify all thermocouple	es read 1250F +/- 10 degrees (l	HT tests only):  Verify PQAR  POAR  POAR	1 B-6-04
6.0.9	Document temperatur	e of test article	Witness PQAR	(8-6-04
6.0.10	Ramp load to approxir inches per minute.	nately 45 pounds at a load rate	not to exceed 5 NASA 380  Witness PQAR	B-6-04
6.0.11	Verify load is at approx functioning.	ximately 45 pounds and all instr 44. 9	rumentation is  Verify PQAR  PQAR  PQAR	8-6-04
6.0.12	Continue increase load	d until failure occurs.:	Witness PQAR	8-6-04/

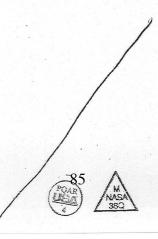
	ED33 / MECH	ANICAL METALLURGY ANI	CORROSION LEAM	
SRB Diagonal Strut Restraint Cable Assembly		SRB-QUAL-04-0064	Revision: Basic	
QŢ	Assembly JALIFICATION TEST	Date: 7/26/04	Page 7 of 9	
6.0.13	Verify load and instru	imentation.	Verify PQAR	8-6-04
<b>¥</b> 6.0.14	Stop video.		N/F	]
6.0.15	Document load and I Failure load 370 . Failure location:	6 16s NA 54 - T	swage inches from cable end other  Verify PQAR	8-6-04

6.0.16 Photograph set-up.

6.0.17 Place broken Restraint Cable debris in Ziploc bag and identify.

Verify PQAR

6.0.18 IF any anomaly or test failure occurs below the expected minimum values, contact the following within 24 hours:
Richard Knochelmann (321) 867-9813 or Chris Epler (321) 867-9309
Cary Cox (321) 867-1757
Pat Roberts (321) 867-1757
Mark Hill (256) 544-4327 or Brian Pung (256) 544-9346



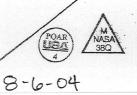
## Attach ment #8

ED33/MECH	ANICAL METALLURGY AND COR	
SRB Diagonal Strut Restraint Cable Assembly	SRB-QUAL-04-0064	Revision: Basic
QUALIFICATION TEST	Date: 7/26/04	Page 6 of 9

	QUALIFICATION TEST	Date: 7/26/04	Page 6 of	9
6.0	TEST OPERATION			
6.0.	Verify calibration is contact accordance with ED3 Verification Procedure	3-WI-012 Mechanica	al Testing Calibration	and NASA 380
6.0.2	Note serial number or	other identification	for the Restraint Cab	le in
	LoT 1048	936 E/L-	& Verif	Ty PQAR PQAR
6.0.3	Mount the Restraint C	Cable into the fixture.	Verif	Ty PQAR POAR
6.0.4	Apply three thermoco Restraint Cable.	uples, one at the top		of the NASA 380 Y POAR POAR 1
6.0.5	5 Photograph set-up.			MASA NASA 389A
6.0.6	Install furnace and he	at to 1250F (HT test	s only). Verif	y POAR POAR
<b>4</b> 6.0.7	Begin video.			NA
6.0.8	Werify all thermocoupl	es read 1250F +/- 1	) degrees (HT tests o	only): vasa y PQAR (roar)
6.0.9	Document temperatur	e of test article.	1951 °F Witness	s PQAR
6.0.1	<ul> <li>Ramp load to approximate inches per minute.</li> </ul>	mately 45 pounds at		ceed 5 NASA 38Q POAR LISA
6.0.1	Verify load is at appro- functioning.	ximately 45 pounds	and all instrumentation	

6.0.12 Continue increase load until failure occurs.:

Witness PQAR PAR 84.04



	ED33 / MECH	ANICAL METALLURGY AND (	CORROSION TEAM	
SRB Dia	agonal Strut Restraint Cable Assembly	SRB-QUAL-04-0064	Revision: Basic	
QT	JALIFICATION TEST	Date: 7/26/04	Page 7 of 9	
6.0.13 <b>4</b> 6.0.14	Verify load and instru	ımentation.	Verify PQAR POAR VA	-6-0
6.0.15	Document load and I Failure load _ 399 Failure location:	.8 165 N/A S 516"-7 ir	wage nches from cable end ther  Verify PQAR	Lloc
6.0.16	Photograph set-up.		NASA 380	86.
6.0:17	Place broken Restra	nt Cable debris in Ziploc	bag and identify.  Verify PQAR  POAR  POAR  POAR  POAR	3-6-0
6.0.18	values, contact the for Richard Knochelman Cary Cox (321) 867- Pat Roberts (321) 86	1757	ris Epler (321) 867-9309	AM NAS

# Attachment #9

ED33 / MECH	ANICAL METALLURGY AND CO	RROSION TEAM
SRB Diagonal Strut Restraint Cable Assembly	SRB-QUAL-04-0064	Revision: Basic
QUALIFICATION TEST	Date: 7/26/04	Page 6 of 9

Q	UALIFICATION TEST	Date: 7/26/04	Page 6 of 9	
6.0	TEST OPERATION			
6.0.1	accordance with ED3	urrent for all calibrated test e 33-WI-012 Mechanical Testir	equipment in ng Calibration and	M NASA 380
	Verification Procedur	es	Verify PQAR	8-6-04
6.0.2	Note serial number of test:	r other identification for the l	Restraint Cable in	(MAR)
	LOT 104	1236 Elv-9	Verify PQAR _	V8-6-C
6.0.3	Mount the Restraint	Cable into the fixture.	Verify PQAR	MASA 380 5-6-04
		will a an at the ten middle		4 M
6.0.4	Apply three thermoco Restraint Cable	ouples, one at the top, middl		104 8-6-04
6.0.5	Photograph set-up.			4 M NASA NASA
6.0.6		eat to 1250F (HT tests only).	Verify PQAR	MASA 380 380 380 380 8-6-04
¥6.0.7	Begin video.		-	U/A
6.0.8	Verify all thermocoup	les read 1250F +/- 10 degre	es (HT tests only): Verify PQAR	NASA 380 POAR 8-6-0
6.0.9	Document temperatu	re of test article. <u>1250</u>	Witness PQAR _	POAR USAS A
6.0.10	Ramp load to approxinches per minute.	imately 45 pounds at a load	rate not to exceed 5	186-0° POAR
			Witness PQAR _	8-6-04
6.0.11	Verify load is at approfunctioning.	eximately 45 pounds and all 43.7	<u></u>	28-Ce-04
6.0.12	Continue increase loa	ad until failure occurs.:	Witness P.QAR _	POAR LEGA 6-04



feet let	ED33 / MECH	ANICAL METALLURGY AN	CORROSION TEAM	
SRB Di	agonal Strut Restraint Cable Assembly	SRB-QUAL-04-0064	Revision: Basic	
QŢ	UALIFICATION TEST	Date: 7/26/04	Page 7 of 9	A .
6.0.13 <b>¥</b> 6.0.14	Verify load and instru	imentation.	Verify PQA	R FOAR 8-6-04
6.0.15	Document load and I Failure load _393.5 Failure location:		swage inches from cable end other Verify PQA	R (FOAR) 8-6-04
6.0.16	Photograph set-up.			MASA 380 8 6 -04
6.0.17	Place broken Restrai	nt Cable debris in Ziplo	c bag and identify. Verify PQA	R (1907) 8-6-04
6.0.18	values, contact the for Richard Knochelman Cary Cox (321) 867- Pat Roberts (321) 86	llowing within 24 hours n (321) 867-9813 or C 1757	hris Epler (321) 867-9309	POAR INSA NASA 380

## Attachment#10

ED33 / MECH	ANICAL METALLURGY AND CORROS	ION TEAM
SRB Diagonal Strut Restraint Cable Assembly	SRB-QUAL-04-0064	Revision: Basic
QUALIFICATION TEST	Date: 7/26/04	Page 6 of 9

	100 100 100 100 100 100 100 100 100 100	Assembly			
	Qī	Assembly  JALIFICATION TEST	Date: 7/26/04	Page 6 of 9	
	6.0	TEST OPERATION			
	6.0.1	Verify calibration is cuaccordance with ED3: Verification Procedure	urrent for all calibrated test e 3-WI-012 Mechanical Testir es	ng Calibration and	ARY COLOG
				Verify PQAR	8-6-04
	6.0.2		other identification for the I	Restraint Cable in	
		test: 207 10	4936 Elv-10	Verify PQAR	~ C8-6-04
	6.Ò.3	Mount the Restraint C	Cable into the fixture.	Verify PQAR FOAR	ASA) 8-6-04
	6.0.4	Apply three thermoco- Restraint Cable.	uples, one at the top, middle		134 134.04
				Verify PQAR	
	6.0.5	Photograph set-up.			18-6-04
	6.0.6	Install furnace and he	at to 1250F (HT tests only).	Verify PQAR	8-6-04
7	£6.0.7	Begin video.		N	A
,	6.0.8	Verify all thermocoupl	es read 1250F +/- 10 degre	es (HT tests only):  Verify PQAR	8-6-04 AR
	6.0.9	Document temperatur	e of test article. $-125$	Witness PQAR	POAR 8-6-04
	6.0.10	Ramp load to approxir inches per minute.	mately 45 pounds at a load		TU
		mones per minute.		Witness PQAR	8-6-64
	6.0.11	Verify load is at appro- functioning.	ximately 45 pounds and all 42.7 /65	instrumentation is  Verify PQAR	25-04
	6.0.12	Continue increase load	d until failure occurs.:	Witness POAR	POAR 8-6-04



	ED33 / MECH	ANICAL METALLURGY AND	CORRUSION LEAM	
SRB Diagonal Strut Restraint Cable Assembly QUALIFICATION TEST		SRB-QUAL-04-0064	Revision: Basic	
		Date: 7/26/04	Page 7 of 9	
6.0.13	Verify load and instru	umentation.	Verify PQAR	NASA SEO BG-O4
6.0.14	Stop video.			MA
6.0.15	Document load and Failure load 400. Failure location:	4/65 N/A	swage inches from cable end	POAR
		_N/A	other  Verify PQAR	MASSA 286-0
6.0.16	Photograph set-up.			10 10 10 10 10 10 10 10 10 10 10 10 10 1
6.0.17	Place broken Restra	int Cable debris in Ziplo	oc bag and identify. Verify PQAR	1 380
6.0.18	values, contact the finding Richard Knochelman Cary Cox (321) 867	-1757	i: hris Epler (321) 867-9309	PQAR USA

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#### 13. ABSTRACT (Maximum 200 words)

This Technical Memorandum presents qualification test results for solid rocket booster diagonal strut restraint cable part number 101276–00313–102/103. During flight this assembly is exposed to a range of temperatures. MIL–W–83420 shows the breaking strength of the cable as 798 kg (1,760 lb) at room temperature but does not define cable strength at the maximum temperature to which the cable is exposed during the first 2 min of flight; 669 °C (1,236 °F). The cable, which can be built from different corrosion resistant steel alloys, may also vary in its chemical, physical, and mechanical properties at temperature. Negative margins of safety were produced by analysis of the cable at temperature using standard knockdown factors. However, MSFC–HDBK–5 allows the use of a less conservative safety factor of 1.4 and knockdown factors verified by testing. Test results allowed a calculated knockdown factor of 0.1892 to be determined for the restraint cables, which provides a minimum breaking strength of 151 kg (333 lb) at 677 °C (1,250 °F) when combined with the minimum breaking strength of 0.317-cm (0.125- or 1/8-in) diameter, type 1 composition rope.

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